

HONO O NA PALI NATURAL AREA RESERVE
MANAGEMENT PLAN

Natural Area Reserves System
State of Hawaii

Department of Land and Natural Resources
1151 Punchbowl Street
Honolulu, Hawaii 96813

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EXECUTIVE SUMMARY

In 1970, Hawaii became one of the first states in the country to recognize the importance of its unique natural resources by establishing the State Natural Area Reserves System (NARS). Governor Waihee and the 1987 Legislature appropriated substantial new funding and legislative mandates to develop and implement management in the NARS. This plan describes the management program for the Hono O Na Pali Natural Area Reserve, established in January 1980 by Executive Order 3161. The Reserve protects perennial streams, lowland and montane forests, rare plants, endemic stream fauna, and forest bird habitat.

The Reserve occupies 3,150 acres in the Hanalei District on the island of Kauai. Stretching from sea level along the picturesque Na Pali coast, the Reserve crosses the famous Kalalau Trail approximately 2.5 miles from the trail head at Haena State Park, and continues rising south to the Reserve's highest point at Pihea (4,284 feet). The Reserve encompasses parts of Hanakapiai and Hanakoa streams and all of Waiahuakua Stream; the southern boundary follows a ridge dividing the Reserve from the Alakai Wilderness Preserve and the Na Pali Kona Forest Reserve.

The Reserve's cliffs and valleys along the Na Pali coast contain many rare plant species, including several candidates for federal listing: Brighamia insignis, Munroidendron racemosum and Wilkesia hobbii. The upper section of the Reserve is rugged and unexplored; the upland forests provide essential watershed. A colony of Dark-rumped Petrel, or 'Ua'u (Pterodroma phaeopygia sandwichensis), an endemic, endangered seabird was heard in the Reserve during this field survey.

Because of the size and inaccessibility of the Reserve, priorities for management of key areas are based on the biological resources and the threats to those resources. Management activity over the next six years will focus on protecting the most intact native bog and forest ecosystems from feral pigs and non-native weeds. Monitoring activities will provide valuable data on the impact of feral ungulates on the Reserve's native ecosystems and the success of management activities.

The general public will be informed about resources within the Reserve and management activities through television, newspaper, and other local media outlets. Volunteer groups will be used for Reserve management whenever feasible. A lodging facility at Kokee for volunteer workers is recommended for the volunteer work program.

A six-year implementation schedule is proposed to accomplish management objectives. An annual budget of \$40,000 will be needed over this time period.

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Finally, sincerest thanks to Governor John Waihee, the State Legislature, and DLNR Chairperson William Paty for their desire and vision to preserve Hawaii's unique natural resources, and for their support of the Natural Area Reserves System.

Michael G. Buck
Natural Area Reserves System Coordinator

HAWAII NATURAL AREA RESERVES SYSTEM

DEPARTMENT OF LAND AND NATURAL RESOURCES

HONO O NA PALI NATURAL AREA RESERVE MANAGEMENT PLAN

I. INTRODUCTION

In 1970, Hawaii became one of the first states in the country to recognize the importance of its unique natural resources by establishing the Natural Area Reserves System (NARS). The NARS is legally mandated to "preserve in perpetuity specific land and water areas which support communities, as relatively unmodified as possible, of the natural flora and fauna, as well as geological sites, of Hawaii" (HRS 195-1). To date, there are 18 reserves on 5 islands, occupying more than 108,000 acres of the state's most biologically diverse ecosystems.

Governor Waihee and the 1987 Legislature appropriated substantial new funding and legislative mandates to develop and implement management in the NARS. Directives were given to write comprehensive management plans for each reserve, based on the most current and relevant biological information available.

This plan describes the management program for the 3,150-acre Hono O Na Pali Natural Area Reserve, established in January 1980 by Executive Order 3161. The Reserve was established to protect perennial streams, riparian and ridgeline lowland and montane forests, rare plants, endemic stream fauna, and forest bird habitat. The plan consists of five parts:

- o a brief Introduction to acquaint the reader with the project and how the plan was prepared;
- o a Resources Summary describing the Reserve's natural resources;
- o a Management plan describing programs recommended to maintain the Reserve's resources with an analysis of alternative actions and impacts;
- o a Budget Summary listing the funds necessary to carry out the management plan; and
- o Appendices describing certain resource information in more detail.

Three major sources of information were used to prepare this plan. The first was The Nature Conservancy's Hawaii Heritage database on rare species and unique natural communities. The second was a field inventory conducted in May 1988, specifically designed to collect data relevant to management of the Reserve's natural resources. The third was a review of this plan by qualified managers, planners, and biologists familiar with the area and its problems.

Survey crews spent eight field days gathering data in May 1988 along eleven transects, ranging from 490 - 4,430 feet in length, and at three supplemental stations (Figure 1 and Appendix 1). Transects sampled the range of vegetation types in the Reserve identified from aerial photographs. Detailed field forms were completed at sampling stations every 165 feet along the transects, noting the presence of natural communities, rare plants, native birds, feral ungulates, and weeds (Appendix 2). No transects were established in the Reserve's inaccessible interior region and helicopter reconnaissance was used to collect vegetative cover information.

This survey was designed to gather management-oriented resource information over a large area in a short time period, and was not intended to be a comprehensive biological inventory. Sampling of small mammals, birds, and invertebrates was incidental rather than systematic. Detailed survey methods are available upon request. A list of plant species currently known from the Reserve is in Appendix 3; a list of bird species is in Appendix 4.

This plan is intended to establish long-range goals and management priorities of the Hono O Na Pali Natural Area Reserve, and to describe specific program and activities to be accomplished during the 1989-1991 biennium. It will be updated biannually to incorporate new knowledge and refine management concepts.



II. RESOURCES SUMMARY

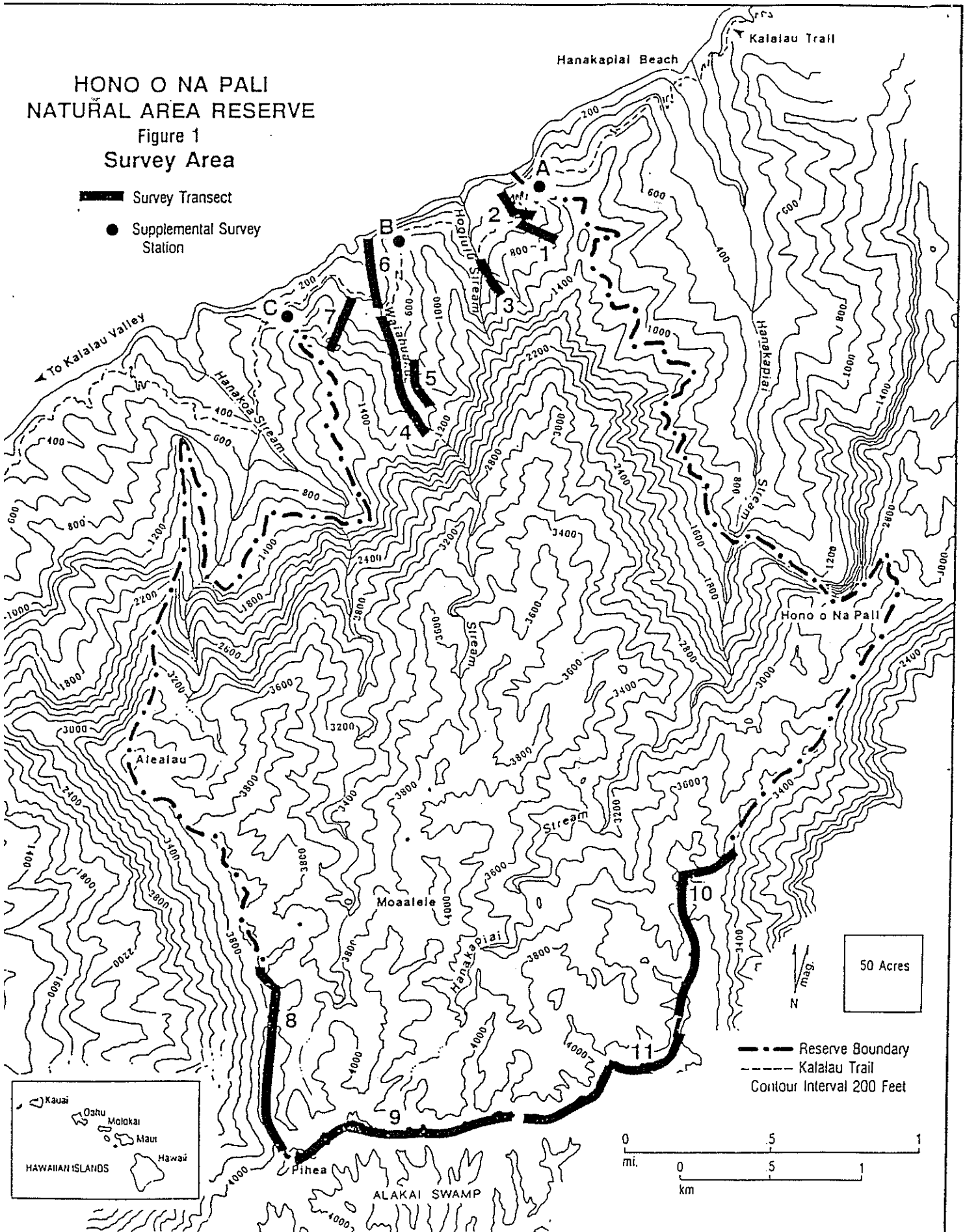
A. General Setting

The Hono O Na Pali Natural Area Reserve occupies 3,150 acres in the Hanalei District on the island of Kauai (Figure 1). Stretching from sea level along the picturesque Na Pali coast, the Reserve crosses the famous Kalalau Trail approximately 2.5 miles from the trail head at Haena State Park, and rises south to the Reserve's highest point at Pihea (4,284 feet elevation). The Reserve is traversed by hikers destined for Kalalau Valley to the east; 51,000 hikers visited the Na Pali Coast State Park during the 1985 - 1986 fiscal year (DLNR 1986). The Reserve encompasses

HONO O NA PALI NATURAL AREA RESERVE

Figure 1
Survey Area

-  Survey Transect
-  Supplemental Survey Station



parts of Hanakapiai and Hanakoa streams and all of Waiahuakua Stream; its western-most point is Alealau peak, and its eastern-most Hono O Na Pali peak. The southern boundary follows a ridge which forms the headwall of the Reserve's valleys, dividing them from the Alakai Swamp Wilderness Preserve and the Na Pali Kona Forest Reserve.

The upper section of the Reserve was put into Territorial Forest Reserve for protection in 1907. Even before that time, the concern for native forest prompted cattle eradication activities in this area during 1882 and 1890. There were cattle and agricultural pursuits in the lower Reserve until it gained Forest Reserve status in 1938. In recent years, the Division of Forestry and Wildlife (DOFAW) has set up a special year-round bow hunting season to reduce goat populations in the lower Reserve.

Annual rainfall in the area averages from 80 inches in the drier coastal lowlands, to more than 160 inches in the upland rain forests (Giambelluca, Nullet, and Schroeder 1986). The Reserve's cliffs and valleys along the Na Pali coast contain many rare plant species, including several candidates for federal listing: Brighamia insignis, Munroidendron racemosum and Wilkesia hobbii. The upper section of the Reserve is rugged and unexplored; the upland forests provide essential watershed. An endemic, endangered seabird, the Dark-rumped Petrel, or 'Ua'u (Pterodroma phaeopygia sandwichensis), was heard in the Reserve during this field survey. This bird is thought to nest only in the upland areas of Maui and the Big Island.

B. Flora

Ten natural communities were observed during this May survey (Table 1). Depiction of the Reserve's vegetation in Figure 2 was compiled from literature and survey information. Due to the limitations of small-scale mapping, only the general natural community pattern can be portrayed in Figure 2. Communities sampled showed complex transitions, and are detailed in the field notes as well as summarized in Appendix 1. Appendix 3 lists native and non-native plant species known from the communities described here.

Three of the communities seen in the Reserve are considered rare: Hawaiian Continuous Perennial Stream, Lama (Diospyros spp.)/'Ohi'a (Metrosideros polymorpha) Lowland Mesic Forest, and 'Ohi'a Mixed Montane Bog (Table 1). For the purposes of this management plan, a natural community is considered rare if it is known from 20 or fewer locations worldwide. Seven other vegetation types made up the other communities seen in the Reserve during this survey; Hala (Pandanus tectorius) Coastal Mesic Forest, Kawelu (Eragrostis variabilis) Coastal Dry Cliffs, Kawelu Lowland Mesic Cliffs, 'Ohi'a/Lapalapa (Cheirodendron platyphyllum) Montane Wet Forest, 'Ohi'a Mixed Shrub Montane Wet

TABLE 1
NATURAL COMMUNITIES OF HONO O NA PALI NATURAL AREA RESERVE

Natural Community	HHP Rank ¹	Acreage ²
Hala Coastal Mesic Forest	3	76
* Hawaiian Continuous Perennial Stream	1	x
Kawelu Coastal Dry Cliffs	3	129
Kawelu Lowland Mesic Cliffs	3	+
Kukui Lowland Wet Forest	E	267
* Lama/`Ohi`a Lowland Mesic Forest	2	82
`Ohi`a/Lapalapa Montane Wet Forest	3	13
* `Ohi`a Mixed Montane Bog	2	6
`Ohi`a Mixed Shrub Montane Wet Forest	3	2,577
`Ohi`a/Uluhe Montane Wet Forest	3	+

* Rare Natural Communities

¹ Key to Hawaii Heritage Program Ranks:

- 1 Critically imperilled globally (typically 1-5 occurrences)
- 2 Imperilled globally (typically 6-20 occurrences)
- 3 Restricted range (typically 21-100 occurrences globally)
- E Exotic; non-native community

² Acreages are based on vegetation types mapped in Figure 2.

Due to mapping and survey constraints, complex transitions between communities, or small patches of communities within others, are not accounted for.

x Acreage too small or scattered to accurately estimate

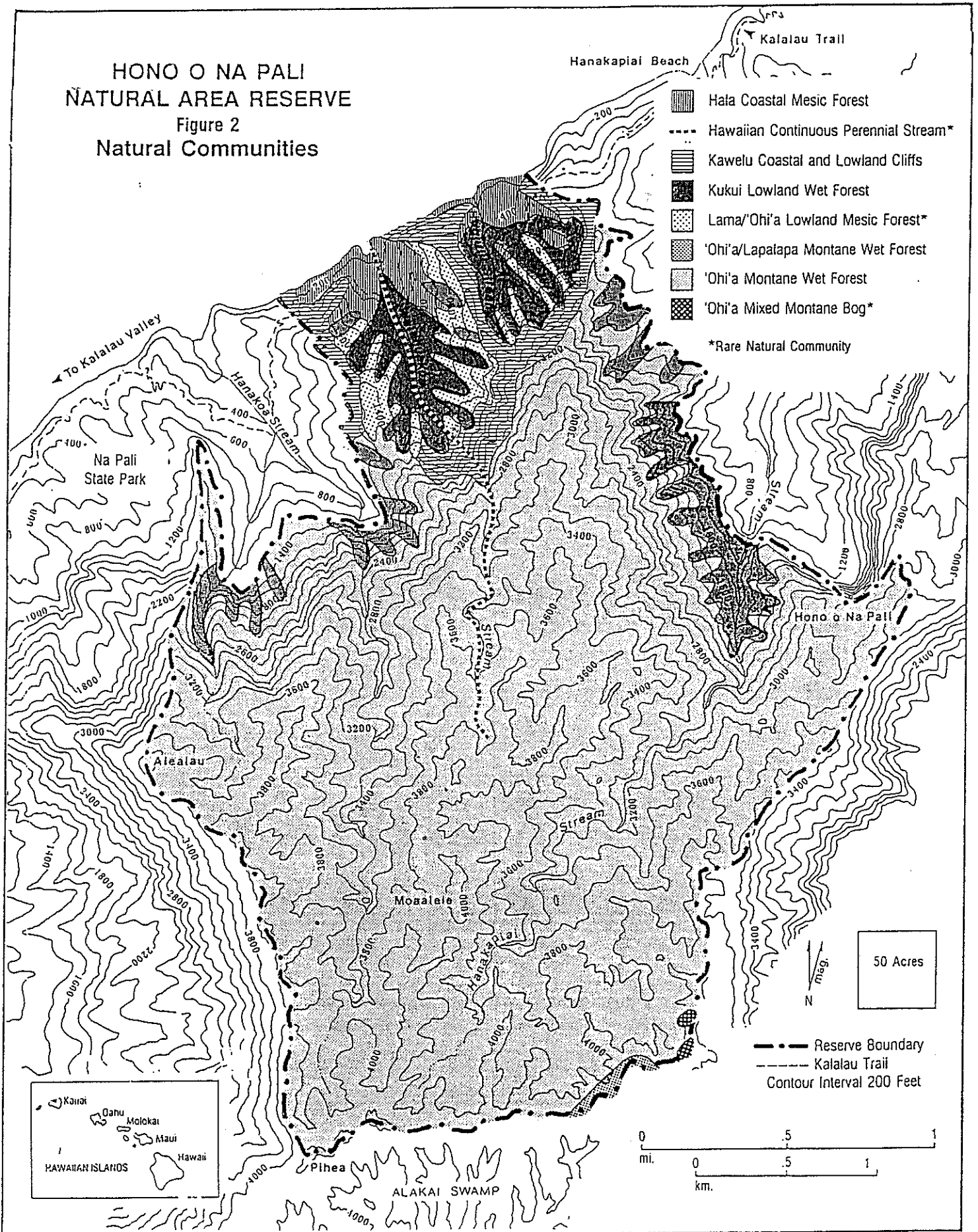
+ Acreage included in preceding community acreage

Forest, `Ohi`a/Uluhe (Mat Fern) Montane Wet Forest, and the non-native-dominated Kukui (Aleurites moluccana) Lowland Wet Forest.

Hawaiian Continuous Perennial Streams are known from all of the major Hawaiian islands, except Lanai. Defined by the presence of native aquatic biota, these unique stream systems require sufficient water to flow throughout the year (perennial), and to remain undiverted and unmodified along their course to the ocean. Although several examples of this rare community occur along the Na Pali Coast, only Waiahuakua Stream is in the Reserve (Figure 2). Several catadromous stream species, `opae (Atyoides bisulcata), Erinna aulacospira, and an unidentified `o`opu, were seen during this survey, an indication that the native stream community is intact.

HONO O NA PALI NATURAL AREA RESERVE

Figure 2
Natural Communities



Hala Coastal Mesic Forests are known from all of the main islands. Along the Na Pali coast generally below 400 feet, hala forests were observed to dominate all of the valleys on gentle to steep slopes (Figure 2). In Hoolulu and Waiahuakua valleys, non-native plants such as ti (Cordyline fruticosa), Oplismenus hirtellus, Lantana camara, Pluchea symphytifolia, guava (Psidium guajava), and air plant (Kalanchoe pinnata) dominated the hala forest understory. However, native species were sometimes abundant and locally dominant, including 'ohi'a, lama (Diospyros sandwicensis), alahe'e (Canthium odoratum), 'akoko (Chamaesyce celastroides var. celastroides), ko'oko'olau (Bidens sp.), 'ama'u (Sadleria cyatheoides), and nehe (Lipochaeta succulenta). Some mosses were noted on moist boulders under the canopy, and a variety of lichens grew on the trunks of the hala trees.

Kawelu Coastal Dry Cliffs were found on narrow ledges and seeps between lava flows on the sea cliffs adjacent to and at the edges of both Hoolulu and Waiahuakua valleys (Figure 2). Within the community, there were sections dominated by one of the other common coastal plants such as Artemisia kauaiensis, 'akoko, nehe, and ko'oko'olau. Other common species included 'ilima (Sida fallax), and the fern Doryopteris decipiens.

Kukui Lowland Wet Forests are dominated by the non-native kukui tree, introduced by the Hawaiians who burned its nut oil for light. Kukui forest covered the gulch bottoms in both Hoolulu and Waiahuakua valleys above 300 feet elevation (Figure 2). The understory of this forest was occupied by non-native species such as mountain apple (Syzygium malaccense), coffee (Coffea arabica), ti, and Oplismenus hirtellus. In the riparian sections of the kukui forest, native plants were sometimes quite abundant. Such species as papala kepau (Pisonia umbellifera), kopiko (Psychotria marianiana), kolea (Myrsine lessertiana), lama (Diospyros sandwicensis and D. hillebrandii), alahe'e, and ferns such as akolea (Athyrium microphyllum), Diplazium sandwichianum, and three rare species, Pittosporum napaliense, Charpentiera densiflora, and the rare loulu, Pritchardia napaliensis, were observed.

Lama/'Ohi'a Lowland Mesic Forest was the predominant vegetation observed in Hoolulu and Waiahuakua on ridge tops above 400 feet elevation (Figure 2). Although this community is found on all the major Hawaiian islands, it is considered rare because it is threatened by non-native plant invasion and damage by feral ungulates. Dominance by lama or 'ohi'a changed with altitude, 'ohi'a becoming most abundant higher on the ridges. Several other native mesic tree species were present in the Lama/'Ohi'a Lowland Mesic Forest canopy, including kalia (Elaeocarpus bifidus), alahe'e, 'ohi'a ha (Syzygium sandwicensis), olopua (Nestegis sandwicensis), 'aulu (Pouteria sandwicensis), halapepe (Pleomele aurea), and kopiko. The understory was often open,

with few native species such as Carex wahuensis spp. wahuensis. Non-native shrubs, herbs, and grasses have displaced the native understory on several of the ridges surveyed.

The upper Hono O Na Pali Reserve is an eroded plateau with a series of ridges and valleys covered with a mosaic of two types of 'ohi'a-dominated forest communities (Figure 2). 'Ohi'a/Mixed Shrub Montane Wet Forest and 'Ohi'a/Uluhe Montane Wet Forest cover the plateau, totalling about 2,577 acres (Table 1). The 'Ohi'a Mixed Shrub Montane Wet Forest observed during the survey occupied ridges near the Reserve boundary. The forest canopy was a mix of 'ohi'a and other native trees such as lapalapa (Cheirodendron platyphyllum ssp. kauense), 'olapa (Cheirodendron trigynum), kawa'u (Ilex anomala), kolea (Myrsine lessertiana and M. alyxifolia), and 'ohe (Tetraplasandra spp.). The mixed shrub layer contained such species as pu'ahanui (Broussaisia arguta), pukiaawe (Styphelia tameiameia), two rare na'ena'e (Dubautia knudsenii ssp. knudsenii and D. k. ssp. negatae), koli'i (Trematolobelia macrostachys), 'ohelo kaula'au (Vaccinium calycinum), alani (Pelea clusiifolia), and kolea (Myrsine alyxifolia). Epiphytic mosses and ferns were present, although not extensively developed. Ground cover consisted of low ferns such as Dryopteris glabra, akolea, and wawae'iole (Lycopodium spp.), herbs such as 'ala'alawainui (Peperomia spp.), pa'iniu (Astelia argyrocoma), and makole (Nertera granadensis), and sedges such as Machaerina angustifolia, Dianella sandwicensis, Gahnia beecheyi, and Carex alligata.

The 'Ohi'a/Uluhe Montane Wet Forest observed in a mosaic with 'Ohi'a Mixed Shrub Montane Wet Forest was best developed on steeper slopes but sometimes occupied ridge tops. Aside from the dominant 'ohi'a, conspicuous mat ferns collectively known as uluhe (Dicranopteris linearis, Sticherus owhyensis, and Diplopterygium pinnatum) formed a nearly continuous understory, broken in places by emergent native trees and shrubs such as pukiaawe, 'ohelo kau la'au, lapalapa, 'olapa, kolea, hoi kuahiwi (Smilax melastomifolia), alani, and Lobelia gaudichaudii.

Only 13 acres of 'Ohi'a/Lapalapa Montane Wet Forests were found along the southern boundary of the Reserve (Figure 2). 'Olapa was usually present, but not dominant. Common subcanopy constituents included 'ohelo kau la'au, na'ena'e (Dubautia raillardioides and D. laxa), pu'ahanui, hoi kuahiwi, uluhe, alani, mokihana (Pelea anisata), kolea (Myrsine lessertiana and M. alyxifolia), kawa'u, koli'i, Lobelia gaudichaudii, 'ala'alawainui, and pukiaawe. In low-lying, poorly drained areas, the native sedge Carex alligata became a prominent constituent of the understory. Epiphytic mosses, liverworts, and ferns were well developed. There was a diverse ground cover of mosses, ferns and thick leaf litter on spongy humus where ground disturbance was minimal.

Only a few small 'Ohi'a Mixed Montane Bogs (totalling about six acres) were seen during this survey in the southeast corner of the Reserve (Figure 2). These are in large part similar to bogs in the Alakai Wilderness Preserve, and are dominated by low-stature 'ohi'a, Rhacomitrium moss, kuolohia (Rhynchospora chinensis var. spiciformis), and Carex sp. A variety of shrubs, herbs and sedges, Oreobolus furcatus, sundew (Drosera anglica), uluhe, and other bog-adapted, low-growing species were present (such as Viola kauaensis, Plantago pachyphylla, and Dubautia waialealae). At bog margins, such species as Viola wailenalenae, 'ohe naupaka (Scaevola glabra), Lobelia gaudichaudii, and the rare Pelea waialealae were seen.

A total of 46 rare plant taxa have been reported from the Hono O Na Pali Reserve area. Three other rare plant taxa are reported in literature for the area, but lack specific enough location information to be listed in or adjacent to the Reserve (Appendix 3). For the purposes of this management plan, a species is considered rare and imperilled if it is known from 20 or fewer locations worldwide, or fewer than 3,000 individuals. Due to changes in taxonomy, some taxa currently listed as candidate species in the most recent Federal Register may no longer be considered rare by the Hawaii Heritage Program, and their federal status is being reevaluated (Herbst pers. com.). Because many native plants lack unique Hawaiian or common names, scientific names are used throughout this section. Hawaiian names, where available, are provided in Table 2.

Of the 46 taxa known from the area, 27 have been reported within the Reserve boundaries (Table 2). Four of those taxa have not been reported since the mid-1950s: Canavalia pubescens, Dubautia microcephala, Lobelia yuccoides, and Wikstroemia hanalei (not reported since 1916). During the survey, 16 of the remaining 23 taxa recently reported within the Reserve (since 1972) were observed (Figure 3).

Wilkesia hobbii was observed on dry cliffs dominated by kawelu (Figure 3). This shrub is found only on the dry northwestern cliffs and ridges of Kauai. Two very small populations of Lepidium serra, and two other populations of Lobelia niihauensis were also seen on the Kawelu Coastal Dry Cliffs community (Figure 3). Hibiscus kokio ssp. saintjohnianus was observed on supplemental stations A and B, and along transects 1 and 7 (Figure 3). All four occurrences were small, with none exceeding 50 individuals. Three of these occurrences were in Kawelu Coastal Dry Cliffs, and the fourth was in Lama/'Ohi'a Lowland Mesic Forest. All known occurrences of this taxa are along the northwestern coast of Kauai. Brighamia insignis was observed at supplemental stations A and B, in Kawelu Coastal Dry Cliff and Hala Coastal Mesic Forest communities (Figure 3). This species is known from only two areas on Kauai, and one 1947 report from Niihau.

TABLE 2
RARE PLANTS OF HONO O NA PALI NATURAL AREA RESERVE

Scientific Name ¹ Former Name ² (Common Name)	Current (Historic) Occurrences ³	Federal Status ⁴	HHP Rank ⁵
* <u>Brighamia insignis</u> (alula, pu aupaka, 'olulo)	2(0)	C1	1
<u>Canavalia napaliensis</u> (`awikiwiki, puakauhi)	1(0)	-	1
<u>Canavalia pubescens</u> (`awikiwiki, puahauhi)	0(1)	C1	1
* <u>Charpentiera densiflora</u> (papala)	2(1)	C2	2
<u>Dubautia knudsenii</u> ssp. <u>nagatae</u> (na`ena`e)	1(0)	-	1
<u>Dubautia microcephala</u> (na`ena`e)	0(1)	C1	1
* <u>Eurya sandwicensis</u> <u>E. sandwicensis</u> var. <u>grandifolia</u> (anini)	2(0)	- C1	2
<u>Hedyotis cookiana</u> (pilo)	1(0)	-	H
<u>Hedyotis elatior</u> <u>H. elatior</u> var. <u>elatior</u> <u>H. elatior</u> var. <u>herbacea</u> (pilo)	1(0)	- C2 C1	?
* <u>Hibiscus kokio</u> ssp. <u>saintjohnianus</u> <u>H. saintjohnianus</u> (koki`o, `ula`ula)	2(1)	- C2	1
* <u>Huperzia sulcinervia</u> (-)	1(0)	-	1
<u>Isodendrion longifolium</u> (-)	1(0)	C1	2
* <u>Lagenifera erici</u> (-)	1(0)	-	1
* <u>Lepidium serra</u> (`anaunau, naunau, kunana)	1(0)	C1	1
* <u>Lobelia niihauensis</u> (-)	1(0)	-	2
<u>Lobelia yuccoides</u> (panaunau)	0(1)	-	2

Key on following page

TABLE 2, CONTINUED
RARE PLANTS OF HONO O NA PALI AREA RESERVE

Scientific Name ¹ Former Name ² (Common Name)	Current (Historic) Occurrences ³	Federal Status ⁴	HHP Rank ⁵
* <u>Munroidendron racemosum</u> (-)	2(0)	C1	1
* <u>Nesoluma polynesicum</u> (keahi)	1(0)	-	2
* <u>Ochrosia kauaiensis</u> (holei)	1(2)	-	1
<u>Panicum napaliense</u> (-)	1(0)	-	1
<u>Pelea puberula</u> (alani)	1(0)	-	1
* <u>Pelea waialealae</u> (alani)	1(0)	-	2
* <u>Peucedanum sandwicense</u> <u>P. sandwicense</u> var. <u>sandwicense</u> <u>P. kauaiense</u> (makou)	2(0)	- C2 C2	2
* <u>Pittosporum napaliense</u> (ho`awa)	3(0)	-	1
* <u>Pritchardia napaliensis</u> (lo`ulu)	2(0)	-	1
<u>Wikstroemia hanalei</u> (`akia)	0(1)	C2	H
* <u>Wilkesia hobbii</u> (`iliau)	1(0)	C1	1

* Observed during 1988 survey.

¹ Wagner and Wagner (1987)

Wagner et al. (in press)

² Following taxonomy used in 1985 Federal Register

³ Current occurrences reported since 1972

⁴ Key to Federal Status (USFWS 1985, 1987):

C1 Candidate for endangered or threatened status

C2 Candidate for endangered or threatened status, information lacking

- No federal status. Described as rare by Hawaiian botanists and confirmed by Heritage data

⁵ Key to Hawaii Heritage Program Ranks

1 Critically imperilled globally (typically 1-5 occurrences)

2 Imperilled globally (typically 6-20 occurrences)

H Historically known (no observations since 1972 throughout its range)

? No more than 100 occurrences globally; rank not yet determined by HHP

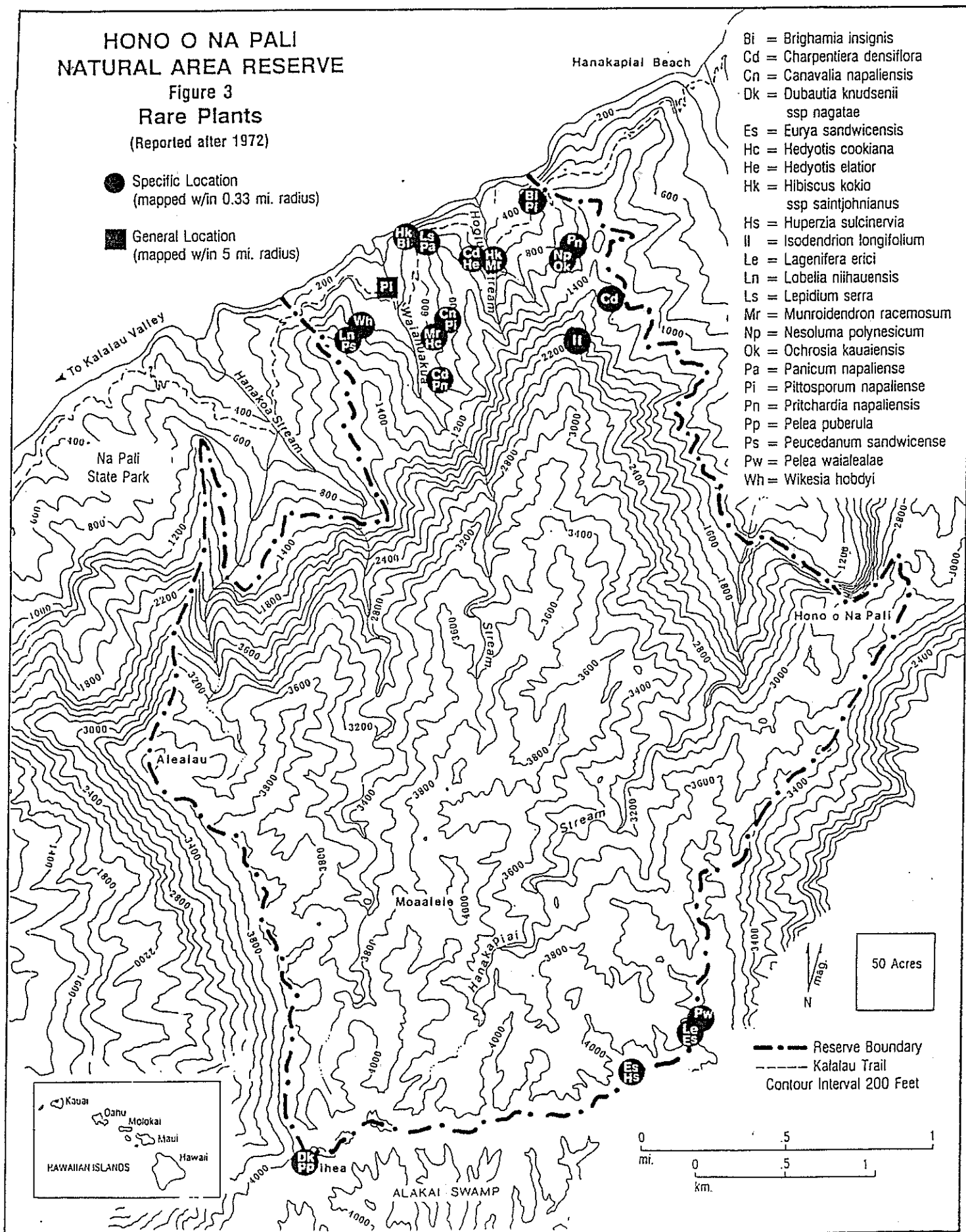
HONO O NA PALI NATURAL AREA RESERVE

Figure 3
Rare Plants
(Reported after 1972)

● Specific Location
(mapped w/in 0.33 mi. radius)

■ General Location
(mapped w/in 5 mi. radius)

- Bi = *Brighamia insignis*
- Cd = *Charpentiera densiflora*
- Cn = *Canavalia napaliensis*
- Dk = *Dubautia knudsenii*
ssp. *nagatae*
- Es = *Eurya sandwicensis*
- Hc = *Hedyotis cookiana*
- He = *Hedyotis elatior*
- Hk = *Hibiscus kokio*
ssp. *saintjohnianus*
- Hs = *Huperzia sulcinervia*
- Il = *Isodendron longifolium*
- Le = *Lagenifera erici*
- Ln = *Lobelia niihauensis*
- Ls = *Lepidium serra*
- Mr = *Munroidendron racemosum*
- Np = *Nesoluma polynesium*
- Ok = *Ochrosia kauaiensis*
- Pa = *Panicum napaliense*
- Pi = *Pittosporum napaliense*
- Pn = *Pritchardia napaliensis*
- Pp = *Pelea puberula*
- Ps = *Peucedanum sandwicense*
- Pw = *Pelea waialealae*
- Wh = *Wikesia hobbii*



Two populations of Peucedanum sandwicense were seen on this survey; one in Kawelu Coastal Dry Cliffs, and one in Kukui Lowland Wet Forest (Figure 3). This species is found on the islands of Kauai, Molokai, and Maui. Three large populations of Pittosporum napaliense were observed during the survey, all at the boundary of Lama/'Ohi'a Lowland Mesic and Kukui Lowland Wet Forests (Figure 3). These three populations constitute all known current examples of Pittosporum napaliense, found only on the Na Pali Coast. Two populations of Pritchardia napaliensis were seen in the Reserve's lama/'ohi'a forest (Figure 3). These constitute the only currently known locations of this species.

Two small populations of Munroidendron racemosum were observed; one population occurred in Hala Coastal Mesic Forest, and the other in Lama/'Ohi'a Lowland Mesic Forest (Figure 3). This tree is found only on Kauai. One population of Nesoluma polynesianum was also seen in the lama/'ohi'a community in Hoolulu Valley. Nesoluma polynesianum is found on all of the major Hawaiian islands.

Ochrosia kauaiensis was also observed in Hoolulu Valley, at the boundary of lama/'ohi'a forest and the Kukui Lowland Wet Forest (Figure 3). Only three plants were noted in this population. Ochrosia kauaiensis is found only along the Na Pali Coast and in the south-central mountains of Kauai. Two large populations of Charpentiera densiflora were observed along transects 1, 2 and 4 (Figure 3). This taxon is found only along the Na Pali Coast.

Two very small populations of Eurya sandwicensis were observed along transects 10 and 11. Both were in rain forests with 'ohi'a canopy. This rare taxon is found on all of the major islands except Lanai. One population of Huperzia sulcinervia was observed in 'Ohi'a Mixed Shrub Montane Wet Forest on a ridge near Pihea. Lagenifera erici was observed in the 'Ohi'a Mixed Montane Bog along Wainiha Ridge. This taxon is found only in bogs of the Alakai Swamp area of Kauai. Pelea waialealae was seen bordering 'ohi'a mixed bogs, and on uluhe-covered slopes along transects 10 and 11.

The seven rare plant species recently reported (since 1972) from the Reserve but not seen during the survey are Canavalia napaliensis, Dubautia knudsenii ssp. nagatae, Hedyotis cookiana and H. elatior, Isodendron longifolium, Panicum napaliense, and Pelea puberula. Many individuals of Dubautia knudsenii were seen during the survey, but it was not possible to determine which variety was seen since they were not flowering at the time of the survey. Both rare varieties, Dubautia knudsenii ssp. knudsenii and D. knudsenii ssp. nagatae are known from the general area.

C. Fauna

The more common Kauai forest birds were seen during the survey in the upper area near Pihea. `Apapane (Himatione sanguinea), Kauai `Elepaio (Chasiempis sandwichensis sclateri), Kauai `Amakihi (Hemignathus virens stejnegeri), `Anianiau (Hemignathus parvus), Kauai `Akepa (Loxops coccineus caeruleirostris), and `I`iwi (Vestiaria coccinea) were observed, and on several occasions Pueo, or Hawaiian Owl (Asio flammeus sandwichensis), was seen (Appendix 4).

A variety of native coastal birds were observed in the coastal portion of the Reserve, including `Iwa (Fregata minor palmerstoni), Brown Booby (Sula leucogaster plotus), and both Red and White-tailed Tropicbirds (Phaethon rubricauda rothschildi and P. lepturus dorotheae, respectively) (Appendix 4).

During the survey, several `Ua`u, or Dark-rumped Petrels (Pterodroma phaeopygia sandwichensis), were heard in the southeast corner of the Reserve near the edge of Wainiha Valley. Beginning at about 8:15 PM, and continuing for approximately two hours thereafter, their distinctive calls were heard on two consecutive nights. The long duration of sustained calls in a specific area strongly suggest a nesting area, which would be the first reported for Kauai.

Another rare bird not seen on the survey, but known from the Reserve area, is Newell Shearwater, or `A`o (Puffinus newelli). This species is listed as threatened (USFWS 1987). Known to breed on Kauai and Hawaii, it is also thought to breed on Molokai and Maui. Birds were heard in 1965 in Kalalau Valley, which borders the west boundary of the Reserve. This threatened species has also been heard in Hanakoa Valley, and the Reserve's Waiahuakua Valley (Banko 1980). No breeding sites have been discovered in Hono O Na Pali Natural Area Reserve, though other breeding colonies are known scattered throughout Kauai. The only documented breeding site along the Na Pali Coast is Milolii, at the western end (USFWS and Telfer 1983).

Four non-native birds were seen during the survey; Japanese White-eye (Zosterops japonicus), Hwamei (or Melodious Laughing-thrush, Garrulax canorus), White-rumped Shama (Copsychus malabaricus), and Erckel Francolin (Francolinus erkelii) were heard (Appendix 4).

Damage to the Reserve's vegetation by feral pigs or goats was seen on all transects during the survey. Control of these ungulates is discussed in detail in the Ungulate Control Program.

The Reserve's variety of habitats, ranging from lowland dry to montane wet, support a large invertebrate fauna of both native and non-native species. The lower elevation coastal valleys

(Hoolulu and Waiahuakua) showed a diversity of non-native invertebrates, but native invertebrates (such as aquatic insects) were also conspicuous during the survey. Native invertebrates were more plentiful in the forested plateau; insects, spiders and the common succinid snails were seen during the survey. An intensive survey of invertebrates in the Reserve would probably yield undescribed species, since the area has been little surveyed.

Information on Hawaiian land snails for the Reserve is limited. Available records indicate that Carelia, a genus endemic to Kauai and Niihau (Arneemann unpub.) and the largest native land snail in the Hawaiian archipelago with a shell of up to 3 inches in length, has been found live only on Kauai (Christensen pers. com.). The most recent record of Carelia kalalauensis in the Reserve is a 1946 report from Hanakoa Valley; the most current record of this species on Kauai is from 1951 in Kalalau Valley, west of the Reserve. C. bicolor was last recorded in 1947 from Hoolulu Valley.

The only conspicuous non-native invertebrates in the forest plateau section of the Reserve were large flies usually associated with feral animals such as pigs. A non-native lizard, the metallic skink, was seen both at Pihea and near the bog, suggesting that this forest lizard is widespread in the Reserve. It may pose a threat to ground-dwelling native invertebrates.

III. MANAGEMENT

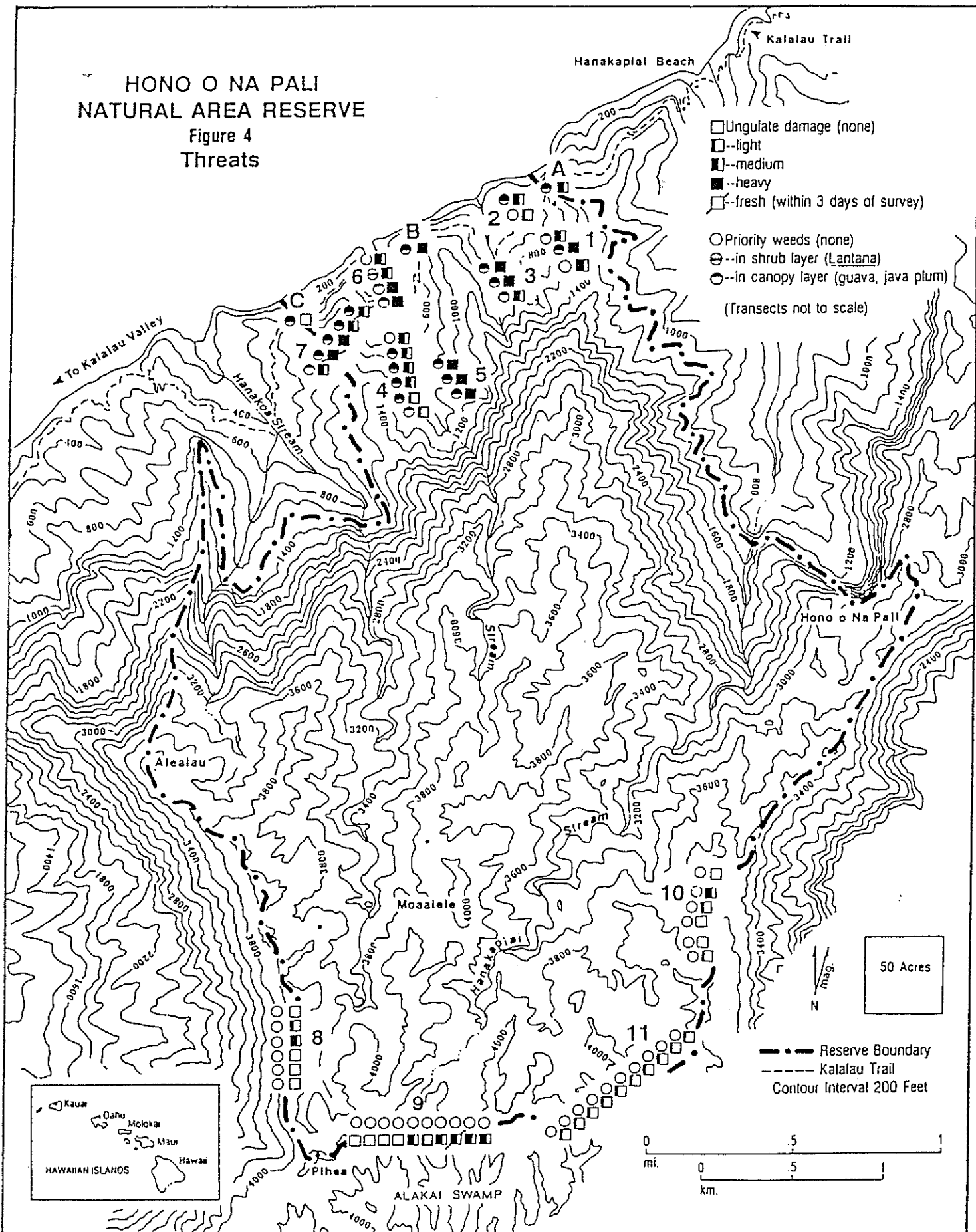
A. Key Management Considerations

The overall management goal is to protect and maintain the Reserve's native ecosystems. The following key considerations were included in the management programs developed to achieve this goal:

- 1) The Hono O Na Pali Reserve is large and relatively inaccessible. At this time it is not necessary or economically realistic to intensively manage the entire Reserve. Fortunately, many of the Reserve's native ecosystems are intact with little immediate threat from non-native species (Figure 4). Intensive management of key areas is proposed and priorities are based on the area's biological resources, the extent of current disturbance, the nature of the other biological threats within and near the areas, and the feasibility of management (e.g. topography and access).
- 2) Pigs and goats constitute a severe threat currently affecting the Reserve. Rooting and wallowing by pigs destroy native plants and the ground cover on the forest

HONO O NA PALI NATURAL AREA RESERVE

Figure 4
Threats



~ floor. Such damage limits effective regeneration of native plants, and creates conditions favorable for certain non-native weeds throughout the Reserve. Goats browse native plants, allowing the establishment of non-native plants, some of which are aggressive weeds. Control of the feral ungulate populations is an essential first step in the maintenance of native plant communities in the Reserve. These activities are outlined in detail in the Ungulate Control program.

- 3) Many non-native plants observed in the Reserve are shade intolerant and pose no major problem as long as the forest canopy and ground cover remain intact. There are non-native weed species in the Reserve, however, which form monotypic stands and displace native vegetation over large areas. These weeds are priority for management. Weed control activities will focus on these invasive priority weeds within key management areas, and other localized areas where these priority weed species are found. These activities are outlined in detail in the Non-native Plant Control program.
- 4) Management of the Reserve must be integrated within the area's spectrum of land uses, especially the Alakai Wilderness Preserve and the popular Na Pali Coast and Kokee state parks. The Reserve crosses the well-used Kalalau Trail at Hoolulu and Waiahuakua valleys along the Na Pali coast. The upper boundary of the Reserve is accessible from Pihea trail, which originates from the Kalalau Valley lookout. The proximity of these popular recreational areas provides an excellent opportunity for public education and an effective volunteer work program.

B. Management Unit Descriptions

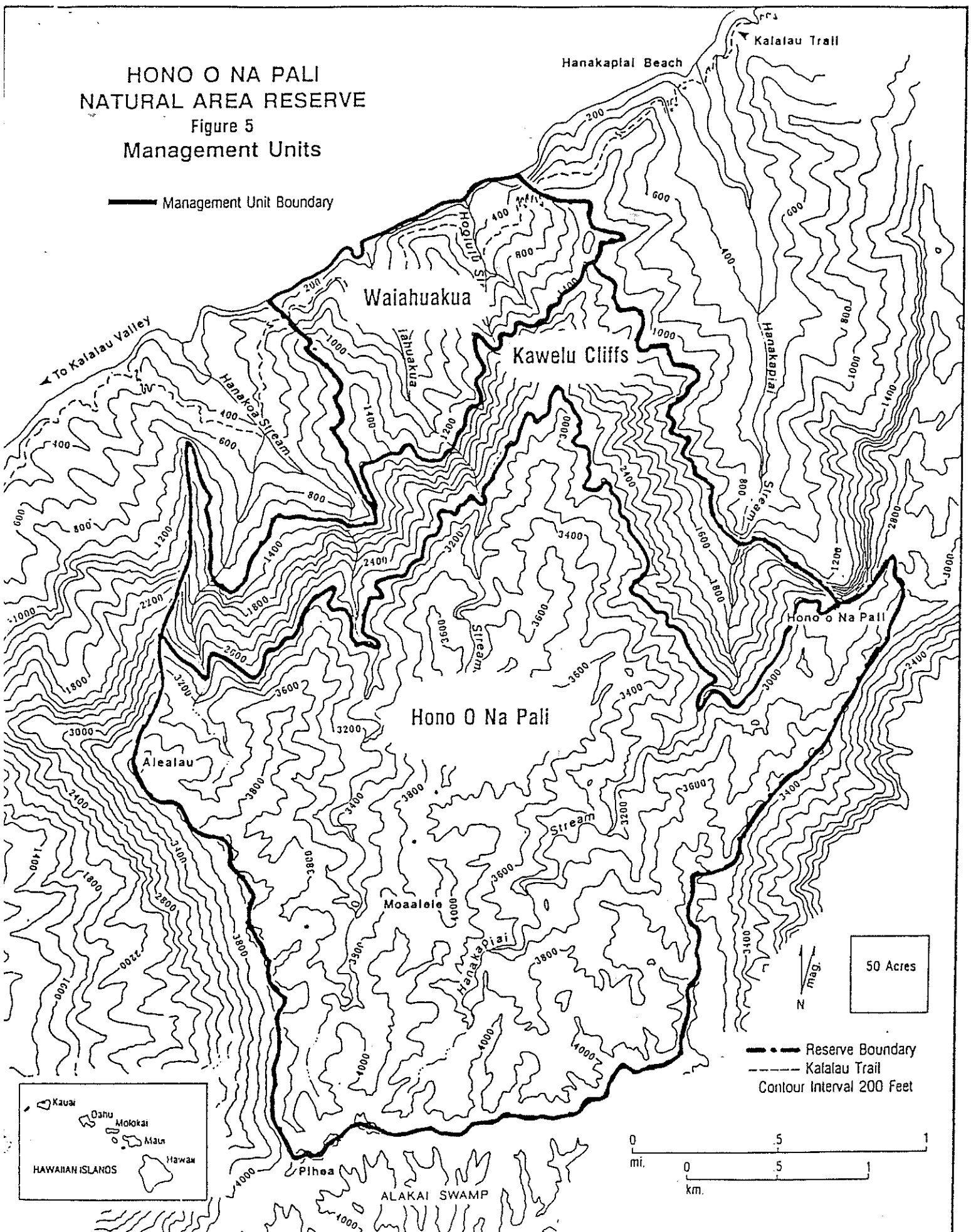
The Reserve has been divided into three management units (Figure 5). Descriptions of each unit follow, with an outline of problems, key program features, and management priorities:

Waiahuakua Unit - This 365-acre unit encompasses part of the Kalalau Trail, and contains a diversity of lowland native and introduced vegetation. Feral goats are a threat to native vegetation as are non-native plants, which are well established throughout the unit. The unit's highest management priority is ungulate control, followed by non-native weed control. Some short sections of fence along select ridges for ungulate control may be needed. Monitoring is needed for aggressive weeds along the popular hiking trails. Additional baseline survey work is needed for native fauna and potential threats in Waiahuakua Stream.

Kawelu Cliffs Unit - This 700-acre unit is made up of steep and mostly inaccessible cliffs containing native grass and forest

Figure 5
Management Units

Management Unit Boundary



communities. Feral goats pose a threat to native plants as they use the rocky cliffs for shelter.

Hono O Na Pali Unit - This 2,085-acre unit contains some of the least disturbed native 'ohi'a forest communities in the entire Reserve system. The extremely rugged topography has protected this unit from both feral ungulates and human-influenced problems. Feral pigs are a concern along the upper boundaries. This unit has the highest priority for weed control, especially for priority weeds already established in adjacent forest areas that could be spread by hunters and hikers. Additional survey work is needed in the unexplored upper drainages of Hanakapiai Stream.

C. Management Programs

The following four management programs outline the long-term goals for the Reserve. A six-year implementation schedule is proposed. Although the programs are listed by priority, they fit together to form an integrated management package.

Priority #1 - Ungulate Control Program (HON-RM-01)

GOAL: Eliminate ungulates in select areas of high biologic value. In the rest of the Reserve, reduce the impact of ungulates to a level that prevents further degradation of the Reserve's native ecosystems and allows the greatest possible recovery of the Reserve's native species.

Statement of the Problem: Feral ungulate control is critical to the survival of native ecosystems in the Reserve. There are many techniques for feral ungulate control. The NARS manager will need the flexibility to use all available tools as the Hono O Na Pali Reserve presents different vegetation types, access problems, target species, and resource protection priorities. These tools include public hunting, fencing, and staff hunting.

Evidence of fresh goat browsing and damage to native plants was apparent in both the Waiahuakua and Kawelu Cliffs units. Goats may be responsible for the lack of native understory plants and regeneration in the hala and kukui forests, as browsing was observed in both communities in Hoolulu and Waiahuakua valleys. Goats were seen on the more accessible cliff faces and fresh ungulate damage was also observed on the valley's adjacent ridges. Because of the proximity of the heavily used Kalalau Trail, the public use of firearms is restricted in this area for safety reasons. Currently, the Waiahuakua and Kawelu Cliffs units in the Reserve are open to year-round bow-hunting with a bag limit of two animals per hunter. Goats may be moving into the Reserve from adjacent Hanakoa Valley.

A component of the feral goat control program is systematic monitoring with exclosure research. Monitoring will evaluate changes in levels of goat damage, the effectiveness of the current management program in reducing damage, and the recovery of native vegetation (See Priority #2 - Monitoring Program). It is uncertain how effective public hunting pressure on goats is in allowing significant native plant recovery. Removal of grazing animals from portions of the Reserve with aggressive non-native weeds could increase the fire danger by allowing build-up of potential fuel, and increase the reservoir of weeds seeds that could be spread by birds. Current animal exclosures in nearby Waimea Canyon indicate certain non-native weeds such as firetree (Myrica faya) are favored by goats. Exclosures in key native communities could provide insight about the effects of current goat browsing on the Reserves' native vegetation.

Old and light feral pig damage was observed along the upper boundary trail, the bogs at Hono O Na Pali, and in the vicinity of the Alakai Swamp trail. The upper boundary had evidence of active public hunting which is probably contributing to the low pig populations.

Alternative Actions and Probable Impacts:

- 1) No action. Accept the potential deterioration of Hono O Na Pali's forest watershed and native resources. Pigs and goats destroy native plants, alter the structure of native vegetation, and contribute to the spread of non-native plants.
- 2) Attempt control of feral ungulates using only liberal public hunting seasons. Do not attempt to use fences, staff hunting, or establishment of research exclosures within the Reserve. Impacts of ungulates under this alternative will probably be roughly the same as alternative #1, except for portions of the Reserve where increased hunting activity may keep ungulate populations down.
- 3) Control feral ungulates with a liberal public hunting season supplemented by staff hunting, fencing, and snaring where necessary. Maintain access trails into priority management areas. Conduct special public hunts, where appropriate, to maintain hunting pressure within the Reserve. Establish research exclosures to determine effectiveness of current hunting pressure. These combined activities have potential to keep feral ungulate populations down, thus allowing recovery of native vegetation. The spread of non-native weed species by feral ungulates can be slowed. Native plant species surviving only as epiphytes because of feral ungulate disturbance can become re-established on the forest floor.

Recommended Action: Alternative #3 is recommended. Different strategies are recommended for control of feral pigs and goats.

At this point in time, inaccessible terrain and public hunting pressure are proving effective in limiting feral pig populations in the Reserve. The existing upper boundary trail along the Reserve's southern boundary will be maintained with a liberal hunting season to increase public hunter effectiveness. This upper boundary trail will not be a general recreational trail, but will be minimally cleared and flagged for hunters and management staff. The rare 'Ohi'a Mixed Montane Bog at the far southeast corner of the Reserve will be fenced to protect it from potential pig disturbance. Monitoring data will indicate if any further staff control will be necessary.

The year-round bow hunting season for goats will be maintained in the lower portion of the Reserve. For safety reasons, the use of firearms is not recommended in the vicinity of the well-traveled Kalalau Trail. Use of firearms could also force goats to become more wary, moving them further into the forest and making their control even more difficult. A short fence may be required to block goat movement along ridges in the Waiahuakua Unit if monitoring indicates ingress from adjacent Hanakoa Valley. Special hunts and logistical support for volunteer hunters may be used to increase public hunting pressure in key areas. The degree and amount of staff hunting needed will be determined by monitoring the effectiveness of the public hunting program and analysis of exclosure data.

Cost/Workload: The following resources will be needed to conduct the ungulate control program:

Year 1:	<u>Personnel</u>	
	Reserve Manager 20 person days (PD)	1,700
	Technician 60 PD	4,200
	<u>Materials and supplies</u>	
	Fencing (Bog)	4,000
	Helicopter support (6 hours)	3,300
	Volunteer support	2,000
	Total	\$15,200

Year 2-6:	<u>Personnel</u>	
	Reserve Manager 15 PD	1,275
	Technician 40 PD	2,800
	<u>Materials and supplies</u>	
	Fence maintenance	500
	Helicopter support (2 hours)	1,100
	Volunteer support	2,000
	Total	\$ 7,675

Salaries are \$85/day for the Reserve manager and \$70/day for a technician/hunter. Volunteer support includes tools and transportation for trail maintenance. Costs will increase if

monitoring and exclosure data indicate need for staff hunting.

Priority #2 - Monitoring Program (HON-RM-02)

GOAL: Monitor the effectiveness of management projects and track significant ecological changes through long-term scientific monitoring.

Statement of the Problem: Management activities may not always achieve desirable results and management efficiency needs to be judged. Monitoring changes in non-native and native plant distribution and animal species abundance entails recording specific data at permanent points and transects in the Reserve. Monitoring also documents progress and facilitates refinement of management techniques employed in the Reserve.

Alternative Actions and Probable Impacts:

- 1) No monitoring program. This could lead to inefficient management resulting from poor understanding of the area's biological needs.
- 2) Conduct ad hoc monitoring whenever possible. This is likely to be considerably less effective in the long run than a systematic approach.
- 3) Establish systematic monitoring programs for ungulate damage, non-native weed invasion, native vegetation recovery, and status of rare species. Establish permanent transects and photo plots along principle ridges and drainages in the Reserve. Establish enclosures to assess impacts of current population of feral goats on native ecosystems.

Recommended Action: Alternative #3 is recommended. Develop monitoring programs to evaluate effects of management activities and identify future management needs. Certain transects will require a two-person crew for safety. Specific goals of the program are to determine: 1) the effectiveness of staff and public hunting in reducing ungulate populations and damage; 2) the recovery of native vegetation; 3) the success of priority weed species control; 4) the location of incipient populations of other priority weeds; and 5) status of known rare species.

Monitoring is recommended in the Waiahuakua Unit and upper boundary trail area twice a year. Aerial reconnaissance will be necessary for the interior of the Hono O Na Pali and Kawela Cliffs units. Two enclosures of one-fifth of an acre will be established in existing lama/'ohi'a communities with different levels of understory disturbance. Similar unfenced control plots in adjacent areas will also be measured to determine impacts of the current level of feral goats. Monitoring for pig and goat populations in the Reserve will determine effectiveness of the

public hunting program and need for additional staff hunting or control efforts.

A more intensive stream survey to confirm and complete a biotic checklist and potential threats is needed for Waiahuakua Stream. Future ground survey work is needed for the interior of the Hono O Na Pali unit, especially in upper Hanakapai drainage.

Cost/Workload: The following resources will be needed to conduct the monitoring project:

Year 1:	<u>Personnel</u>	
	Reserve Manager (30 PD)	\$ 2,550
	Technician (40 PD)	2,800
	<u>Materials and supplies</u>	
	Fencing (Exclosures)	4,000
	Helicopter (4 hours)	2,200
	Supplies	1,000
	Total	\$ 12,550

Year 2-6:	<u>Personnel</u>	
	Reserve Manager (25 PD)	\$ 2,125
	Technician (20 PD)	1,400
	<u>Materials and supplies</u>	
	Helicopter (2 hours)	1,100
	Supplies	2,000
	Total	\$ 6,625

Helicopter is \$550/hr. Salaries are \$85/day for reserve manager and \$70/day for a technician. Helicopter support will be needed for exclosure construction. Supplies include computer and office supplies for data gathering and analysis. Portions of data gathering and analysis could be contracted out.

Priority #3 - Non-Native Plant Control Program (HON-RM-03)

GOAL: To limit the spread and, where possible, eradicate non-native plant species which are already or may become invasive weeds in the Reserve.

Statement of the Problem: Many non-native plants have become established in Hawaii and their total removal from the Reserve is not feasible. The best control strategy is maintenance of intact native forests through limitation of disturbance. While ungulate control will help, it is not completely effective in limiting weed spread, as many weeds are spread by birds and people.

Control of priority weed species in key management units will be necessary. Priority weed species are capable of forming monotypic stands and displacing native vegetation over large

areas. Manual and chemical weed control are costly and priorities for their use should be set by the nature of the weed, the value of the area it is invading, and the effectiveness of the control measure. Biocontrol is an important potential tool in the management of wide spread priority weed species and the NARS should support interagency biocontrol projects.

Steeper cliffs dominated by native vegetation in the Waiahuakua and Kawela Cliffs units were virtually weed-free, but non-native plants were evident throughout the rest of these two units. Large sections along the coast were dominated by guava (Psidium guajava and P. cattleianum), java plum (Syzygium cumini), lantana (Lantana camara), molasses grass (Melinis minutiflora), and perennial foxtail (Setaria gracilis). Stream beds and gulches were dominated by the non-native kukui forest and included non-native weeds such as guava, mountain apple (Syzygium malaccense), thimbleberry (Rubus rosifolius), airplant (Kalanchoe pinnata), Oplismenus hirtellus, and fireweed (Erechtites valerianifolia).

In the Hono O Na Pali unit, blackberry (Rubus argutus) is a priority weed. This plant was found in areas with no apparent ungulate disturbance; presumably it is being dispersed by birds. Broomsedge (Andropogon virginicus) should also be considered a priority weed in this section. Invasion of the upper bogs by Juncus planifolius is another concern. There are other priority weeds well established in areas adjacent to the Reserve; Clidemia hirta, firetree, and banana poka (Passiflora mollissima) should be removed immediately if found within the Reserve.

Alternative Actions and Probable Impacts:

- 1) Control pigs and goats, but do not attempt to control any priority non-native plant species. This will reduce the spread of many ungulate-dispersed plant species, but will allow continued advance of plants spread by birds and people. Decreased rooting and disturbance to the forest floor by pigs will slow down establishment of many non-native plants, but already established plants may continue to spread unchecked. Decreased browsing of native vegetation by goats should help reduce certain shade-intolerant non-native plants. A few especially aggressive weeds could overwhelm large areas.
- 2) Control priority non-native weed species in the key management areas before they become widely established. Set up monitoring transects to locate other incipient populations of priority weed species. Management measures would include selective use of approved herbicides and manual removal with hand tools.
- 3) Control all non-native plant species in the Reserve. This alternative would require substantial resources and is not

practical.

Recommended Action: Alternative #2 is recommended. Conduct priority non-native plant removal along trails as part of periodic maintenance. Look for and map priority weeds along monitoring transects, especially Clidemia hirta, blackberry, firetree, and banana poka and remove these localized populations. In the relatively pristine Hono O Na Pali unit, removal of priority weeds where encountered, will help maintain the integrity of the forest ecosystem with relatively little expense.

Research on non-native plant control is ongoing in the national parks. Detailed records of the control methods' effectiveness in the Reserve will be kept, as careful monitoring and documentation is very important. Coordination between NARS and other agencies involved in plant control work will reduce management costs by employing tested control methods. The NARS should support ongoing interagency efforts of biological control of noxious weeds by lobbying where appropriate and providing research sites and logistical support for demonstration projects.

Strict sanitary conditions should be established to ensure management personnel do not transport weed seeds into the Reserve on their shoes or equipment (including helicopters). Hikers and hunters will be informed of the possibility of contributing to this problem and encouraged to clean their shoes and equipment through posted signs along popular access trails into the Reserve. The public should be discouraged from entering into the weed-free interior of the Hono O Na Pali management unit.

Cost/Workload:

Year 1:	Reserve Manager (10 PD)	\$ 850
	Technician (40 PD)	\$ 2,800
	Supplies and support	\$ 2,000
	Total	\$ 5,650
Year 2-6:	same as Year 1	Total \$ 5,650

Salaries are \$85/day for reserve manager and \$70/day for technician. Supplies and support include tools, herbicides, and logistical support for volunteer and staff work crews.

Priority #4 - Public Education and Volunteer Support Program
(HON-RM-04)

GOAL: To build public understanding and support for the Reserve and the NARS in the local community. To provide educational opportunities for interested groups. To encourage volunteer labor to help staff in management activities.

Statement of the Problem: Most residents and visitors are unaware of Hawaii's natural heritage. Even fewer realize that native resources and the benefits they provide are being threatened. Management of this Reserve will be a long-term effort, and public support is essential.

Volunteer groups have proven successful in certain natural area management activities, especially in labor intensive efforts such as fence construction, weed control, and trail maintenance. These groups tend to be extremely motivated, representing a valuable resource for the Reserve manager.

Alternative Actions and Probable Impacts:

- 1) Do not attempt to inform the general public about the resources protected in the reserve or explain reasons for specific management actions. Do not use volunteer groups in relevant management activities in the reserve. The results of this alternative could include less public and legislative support for the NARS, misunderstanding among certain groups resulting in vandalism of capital improvements, and increased costs for overall NARS management, especially in plant control work.
- 2) Maintain the community outreach program to give public presentations, provide informational material, and utilize concerned volunteer groups. This could result in cooperation with the general public in feral pig and non-native plant control programs and result in less expensive yet more effective management results. It could also provide a local constituency that would support Reserve management activities.

Recommended Action: Alternative #2 is recommended. Inform the general public about resources within the Reserve and management activities through television, newspaper, and other local media outlets. Utilize volunteer groups for Reserve management whenever feasible. Present slide shows and lead nature hikes for interested community groups. Develop a brochure that describes the resources and ongoing management activities within the Reserve.

A lodging facility at Kokee for volunteer workers is recommended for the volunteer work program. There are existing state-owned cabins in the Kokee State Park that would be ideally suited for this purpose.

Cost/Workload:

Year 1 - Reserve Manager (10 PD)	\$ 850
Technician (15 PD)	1,050
Support and supplies	<u>1,000</u>
Total	\$ <u>2,900</u>

Year 2 - Reserve Manager (20 PD)	\$ 1,700
Technician (30 PD)	2,100
Volunteer lodging facility upgrade	20,000
Brochure	6,000
Support and supplies	1,000
Total	\$30,800
Year 3-6 Reserve Manager (10 PD)	\$ 850
Technician (20 PD)	1,400
Support and supplies	4,000
Total	\$ 6,250

Salaries are \$85/day for reserve manager and \$70/day for a technician. Expenses for a volunteer lodging facility are for improvements of an existing state-owned cabin in Kokee. Supplies and support include brochures, audio-visual aids, and maintenance of volunteer facility.

D. Boundary Administration and Special Uses

Participation and cooperation between Department of Land and Natural Resources divisions and their respective land uses is an important factor for effective management of the Hono O Na Pali Reserve. Reserve management plans should be reviewed and coordinated with the State Park's recreational program. Cooperative management activities in the Reserve and the adjacent Alakai Wilderness Preserve should be considered whenever possible, as they share common goals and resource threats. There is a well-preserved set of agricultural rock walls in lower Waiahuakua Valley and NARS staff should work with interested parties to provide interpretative information and possibly utilize this resource for educational purposes.

IV. BUDGET SUMMARY

When this plan was prepared, the long-term funding and organizational structure of the NARS had not been settled. Coordination and implementation of priority projects among the 18 reserves may be affected by future organizational and funding decisions. This may require some revision in the priority projects described here.

A six-year implementation schedule is presented to accomplish management goals as efficiently as possible. Four management programs are proposed to achieve this. Although listed by priority, they build upon each other to form an integrated strategy.

The budget summary is based on a NARS integrated within the Division of Forestry and Wildlife. The budget summary shown is

for the management of the Hono O Na Pali NAR only. It does not include all the administrative, clerical, and facility support needed to run a state-wide NARS or to manage the other natural area reserve on the island of Kauai. These infrastructure costs for the NARS will be identified and documented separately.

Operations costs such as vehicles (a four-wheel drive truck with radio), two portable radios, and maintenance for vehicles and equipment are included in program HON-OP-01. Starting with year 3, a 1 percent inflation increase is incorporated into every annual total, with an additional 1 percent each subsequent year (e.g. year 3 includes 1 percent, year 4 includes 2 percent, year 5 includes 3 percent, etc.).

BUDGET SUMMARY
HONO O NA PALI NATURAL AREA RESERVE

PROGRAM	YR 1	YR 2	YR 3*	YR 4*	YR 5*	YR 6*
HON-RM-01	15,200	7,700	7,700	7,700	7,700	7,700
HON-RM-02	12,600	6,700	6,700	6,600	6,600	6,600
HON-RM-03	5,700	5,700	5,700	5,700	5,700	5,700
HON-RM-04	2,900	30,800	6,300	6,300	6,300	6,300
HON-OP-01	25,000	2,500	2,500	2,500	2,500	2,500
TOTAL (\$)	61,400	53,300	29,100	29,400	29,700	30,000

MANAGEMENT PROGRAMS

HON-RM-01 - Ungulate Control (Priority 1)
HON-RM-02 - Monitoring (Priority 2)
HON-RM-03 - Non-native Plant Control (Priority 3)
HON-RM-04 - Public Education and Volunteer Support(Priority 4)
HON-OP-01 - Operating Expenses

PERSONNEL (PD = person days)

YR 1 -R. Manager 70 PD Technician 155 PD	YR 4 -R. Manager 60 PD Technician 120 PD
YR 2 -R. Manager 70 PD Technician 130 PD	YR 5 -R. Manager 60 PD Technician 120 PD
YR 3 -R. Manager 60 PD Technician 120 PD	YR 6 -R. Manager 60 PD Technician 120 PD

* Starting with year 3, a 1 percent inflation increase is incorporated into each yearly total, with an additional 1 percent each subsequent year (e.g. year 3 includes 1 percent, year 4 includes 2 percent, year 5 includes 3 percent, etc.).

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APPENDIX 1
Hono O Na Pali Natural Area Reserve
Transect Specifications

Transect number	Transect length (ft)	No. of substations	Natural communities surveyed
1	984	7	Kukui Lowland Wet Forest Lama/'Ohi'a Lowland Mesic Forest
2	492	4	Kukui Lowland Wet Forest Hala Coastal Mesic Forest
3	984	7	Kawelu Coastal Dry Cliffs
4	2,460	16	Kukui Lowland Wet Forest
5	984	7	Lama/'Ohi'a Lowland Mesic Forest
6	1,804	12	Kukui Lowland Wet Forest Hala Coastal Mesic Forest
7	1,968	13	Hala Coastal Mesic Forest Lama/'Ohi'a Lowland Mesic Forest Kawelu Coastal Dry Cliffs
8	2,460	16	'Ohi'a Mixed Shrub Montane Wet Forest 'Ohi'a/Uluhe Montane Wet Forest
9	4,428	28	'Ohi'a Mixed Shrub Montane Wet Forest 'Ohi'a/Uluhe Montane Wet Forest
10	2,460	16	'Ohi'a Mixed Montane Bog 'Ohi'a/Uluhe Montane Wet Forest
11	4,428	28	'Ohi'a Mixed Montane Bog 'Ohi'a/Lapalapa Montane Wet Forest 'Ohi'a Mixed Shrub Montane Wet Forest
A	n/a	1	Hala Coastal Mesic Forest
B	n/a	1	Kawelu Coastal Dry Cliffs
C	n/a	1	Kawelu Coastal Dry Cliffs Hala Coastal Mesic Forest

Survey Participants

Michael Buck, DOFAW, Survey Forester
Samuel Gon III, TNCH, Ecologist
Steve Perlman, TNCH, Field Coordinator

DOFAW= State Division of Forestry & Wildlife, Department of
Land and Natural Resources
TNCH = The Nature Conservancy of Hawaii

NATURAL COMMUNITY FIELD OBSERVATION FORM
DATE: _____ TIME START: _____ END: _____
OBSERVER(S): _____ STATION#: _____ ELEVATION: _____
HC NAME: _____
HAR NAME: _____ QUAD NAME: _____
SUBSTRATE: _____
ADJ NCS: _____

DESCRIPTION LINE: _____
ASPECT SLOPE TOPOGRAPHIC CANOPY MOISTURE NC AREA
CLOSURE POSITION STATE
N FLAT GENTLE CREST <1M INUNDATED <1 AC
E GENTLE MOD UPPER SLP 1-2.5M SATURATED 1-5 AC
S MOD MID SLP 2.5-5M MOIST 6-10 AC
H STEEP LOW SLP 5-10M MOIST-DRY >10 AC
() VERT BOTTOM >10M DRY ()

*COVER CLASS CODES: 1 = <1% 2 = 1-5% 3 = 5-25%
(FOR USE BELOW) 4 = 25-50% 5 = 50-75% 6 = 75-90% 7 = >90%
A. CANOPY DOMINANTS: _____
SPECIES T S H *COVER AVE DIA REMARKS

B. SUBCANOPY DOMINANTS: _____
SPECIES T S H *COVER REMARKS
LITTER: _____ BARE GROUND: _____ SPECIES LIST ATTACHED: Y N
THREATS: _____
PROTECTION/MANAGEMENT RECOMMENDATIONS: _____

ED RANK: _____ A = EXCELLENT B = FAIR-GOOD C = POOR D = DEGRADED
ED BOUNDARIES MAPPED: Y N MAP ATTACHED: Y N PHOTO #:

PLANT FIELD OBSERVATION FORM
NAR NAME: _____ ISLAND: _____ QUAD NAME: _____
DATE: _____ SPECIES NAME: _____ SITE NAME: _____
OBSERVER(S): _____
PHOTO TAKEN: Y N
SPECIMEN #, COLLECTOR, REPOSITORY: _____
DIRECTIONS: _____

ELEVATION: _____
GENERAL DESCRIPTION OF AREA: _____
EODATA: _____

NATURAL COMMUNITY: _____
ASSOCIATED NATIVE SPECIES: _____
ASSOCIATED WEED SPECIES: _____
THREATS: _____
PROTECTION/MANAGEMENT RECOMMENDATIONS: _____
COMMENTS: _____

ASPECT		SLOPE	LIGHT	TOPOGRAPHIC POSITION	MOISTURE	DOMINANT SPECIES	%COVER
N	FLAT	DENSE	CREST	INUNDATED			
E	GENTLE	CLOSED	UPPER SLP	SATURATED			
S	MOD	OPEN	MID SLP	MOIST			
H	STEEP	SCATTER	LOW SLP	DRY-MESIC			
()	VERT	VERY SC	BOTTOM	DRY			

HABIT		PHENOLOGY		STRUCTURE	VIGOR	FREQUENCY	POPULATION SIZE	POPULATION AREA (M ²)
TREE	IN LEAF	\$SDGLS	DYING	COMMON	ACTUAL	1		
SHRUB	IN BUD	\$IMM	FEEDLE	OCCAS	1-10	1-5		
HERB	IN FLOWER	\$MAT	NORMAL	RARE	10-50	5-10		
VINE	IMM FRUIT	\$SENESC	VIGOROUS	SOL	50-100	10-100		
PROST	MAT FRUIT				100-1000			
	DORMANT				1000+			

TRANSECT STATION FIELD FORM

NC Name: _____ Time Start: _____ End: _____ Date: _____

Observer(s): _____ MAR Name: _____

Transect#: _____ Station#: _____ Elevation: _____ Bearing: _____

Description Line: _____ Photo #: _____

INCIDENTAL OBSERVATIONS: _____

CUK ITEM: _____

REMARKS: _____

Birds Native Inverts Small Mammals Non-native Inverts Fire Erosion Human Influence Add'l Survey Needs	
--	--

ASPECT	SLOPE	CANOPY CLOSURE	TOPOGRAPHIC POSITION	CANOPY STATURE	SOIL MOISTURE
NORTH	FLAT	DENSE	CREST	<1 M	INUNDATED
EAST	GENTLE	CLOSED	UPPER SLP	1-2.5 M	SATURATED
SOUTH	MOD	OPEN	MID SLP	2.5-5 M	MOIST
WEST	STEEP	SCATTER	LOW SLP	5-10 M	MOIST-DRY
()	VERT	VERYS	BOTTOM	>10 M	DRY
NO CHG	NO CHG	NO CHG	NO CHG	NO CHG	NO CHG

Additional notes:

TRANSECT STATION FIELD FORM

Observer(s): _____ End: _____ Date: _____

NC Name: _____ NAR Name: _____

Transsect: _____ Station#: _____ Elevation: _____

Description Line: _____ Bearing: _____

INCIDENTAL OBSERVATIONS: _____ Photo #s: _____

CHK ITEM: _____

REMARKS:	Birds Native Inverts Small Mammals Non-native Inverts Fire Erosion Human Influence Add'l Survey Needs
----------	--

ASPECT	SLOPE	CANOPY CLOSURE	TOPOGRAPHIC POSITION	CANOPY STATURE	SOIL MOISTURE
NORTH	FLAT	DENSE	CREST	<1 M	INUNDATED
EAST	GENTLE	CLOSED	UPPER SLP	1-2.5 M	SATURATED
SOUTH	MOD	OPEN	MID SLP	2.5-5 M	MOIST
WEST	STEEP	SCATTER	LOW SLP	5-10 M	MOIST-DRY
()	VERT	VERVSC	BOTTOM	>10 M	DRY
NO CHG	NO CHG	NO CHG	NO CHG	NO CHG	NO CHG

Additional notes:

[illegible][illegible]

APPENDIX 3
Hono O Na Pali Area
Vascular Plant Species List

This species list was compiled from available literature sources, personal communication with botanists familiar with the area (backed by specimen verification for rare plants), and field identification during this NARS field survey. Rare plants (less than 3,000 individuals, or known from fewer than 20 locations worldwide) with specific location information are noted by '+' and are either in the Reserve or its adjacent area (see the rare plants table for those confirmed in the Reserve). Rare plants thought to occur in the Reserve but which lack specific location information are noted by '#' in the status column.

Due to subjective location information, some plant species included on this list may not actually be present in the Reserve. Plants and their associated vegetation types reported from literature for the area, but not confirmed during this survey, are noted with an 'x'. Plants reported for the area without an associated vegetation type are assigned to the natural community they would most likely occur in with a '?'.

Descriptions of natural communities are in the text. Taxonomy follows Wagner et al. (in press) and Wagner and Wagner (1987).

Status	Taxon	Kawelu Coastal Dry Cliffs	Hala Coastal Mesic Forest	Lama/Ohia Lowland Mesic Forest	Kukui Lowland Wet Forest	Ohia/Uluhe Montane Wet Forest	Ohia Mixed Shrub Montane Wet Forest	Ohia/Lepalapa Montane Wet Forest	Ohia Mixed Montane Bog
N	<i>Abutilon grandifolium</i>	?	?						
E	<i>Acacia koa</i>			?		?	?	?	
N	<i>Acanthospermum australe</i>	?	?	?	?	?	?	?	?
E	<i>Adenophorus</i>					*		*	
	<i>hymenophylloides</i>								
E	<i>Adenophorus tamariscinus</i>					*	*	*	*
I	<i>Adenostemma lavenia</i>			*	*				
I	<i>Adiantum capillus-veneris</i>			*	*				
N	<i>Adiantum hispidulum</i>				?	?	?	?	
N	<i>Agave sisalana</i>	?	?	?					
N	<i>Ageratum conyzoides</i>	*	*	*	*				
N	<i>Agrostis semiverticillata</i>	?	?	?					
N	<i>Aleurites moluccana</i>		*	*	*				
N	<i>Aloe vera</i>	?	?	?	?				

R = Rare N = Non-native I = Indigenous E = Endemic

* = Confirmed in NARS field study x = Cited in literature sources

? = Cited in literature sources; needs confirmation in natural community

Status	Taxon	Kawelu Coastal Dry Cliffs	Hala Coastal Mesic Forest	Lama/Ohia Lowland Mesic Forest	Kukui Lowland Wet Forest	Ohia/Uluhe Montane Wet Forest	Ohia Mixed Shrub Montane Wet Forest	Ohia/Lapalapa Montane Wet Forest	Ohia Mixed Montane Bog
+ E	Alsinidendron lychnoides							?	?
E	Alyxia oliviformis			*	*		*		
N	Anagallis arvensis	?	?	?	?	?			
E	Antidesma sp.				*				
E	Argemone glauca var. glauca	?	?	?					
E	Artemisia kauaiensis	*	*						
E	Asplenium contiguum					*	*	*	
I	Asplenium nidus			*					
E	Astelia argyrocoma					*	*	*	*
E	Athyrium microphyllum				*	*	*	*	
N	Axonopus fissifolius					*	*		
N	Bambusa sp.				*				
N	Bidens pilosa	*	*						
E	Bidens sp.	*	*	*					
N	Blechnum occidentale	*	*	*	*				
E	Bobea elatior				*				
E	Boehmeria grandis				*				
+ E	Bonamia menziesii	?	?	?					
N	Breynia disticha var. disticha f. nivosa	?	?	?	?				
+ E	Brighamia insignis	*	*						
E	Broussaisia arguta					*	*	*	*
I	Caesalpinia major	?	?	?	?	?			
+ E	Canavalia napaliensis				?	?			
+ E	Canavalia pubescens	?	?	?					
I	Canthium odoratum	*	*	*	*				
E	Capparis sandwichiana	?	?	?					
E	Carex alligata					*		*	
E	Carex sp.						*		*
E	Carex wahuensis ssp. wahuensis	*	*	*	*	*			
N	Carica papaya			?	?	?			
N	Cascabela thevitia			?	?	?			
I	Cassytha filiformis	*							
N	Casuarina sp.	*	*						
N	Catharanthus roseus	?	?	?					
N	Cenchrus echinatus	?	?	?	?				
N	Centella asiatica		*						
N	Cerastium sp.			*	*				
N	Chamaecrista nictitans	*	*						
E	Chamaesyce celastroides var. celastroides	*	*	*					
N	Chamaesyce hirta	?	?	?	?				
E	Chamaesyce sp.	?	?	?	?				

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? = Cited in literature sources; needs confirmation in natural community

Status ~ Taxon

	Kawelu Coastal Dry Cliffs	Hala Coastal Mesic Forest	Lama/'Ohi'a Lowland Mesic Forest	Kukul Lowland Wet Forest	'Ohi'a/Uluhe Montane Wet Forest	'Ohi'a Mixed Shrub Montane Wet Forest	'Ohi'a/Lapalapa Montane Wet Forest	'Ohi'a Mixed Montane Bog
+ E Charpentiera densiflora				*				
E Charpentiera obovata		*						
E Cheirodendron platyphyllum ssp. kauiense					*	*	*	*
E Cheirodendron trigynum					*	*	*	
N Chloris barbata	?	?	?	?				
N Chloris virgata	?	?	?	?				
N Chrysopogon aciculatus	?	?	?	?	?			
E Cibotium chamissoi						*		
E Cibotium glaucum			*	*	*	*		*
E Cibotium splendens					*	*	*	
N Cirsium vulgare	?	?	?	?	?			
N Citrus sp.			*					
E Clermontia clermontioides					*	*		
N Cocos nucifera	?	?	?	?	?			
N Coffea arabica		*		*				
N Coix lachryma-jobi		?	?	?	?			
N Colocasia esculenta		*		*				
N Commelina diffusa	?	?	?	?	?			
N Conyza bonariensis	*							
N Conyza canadensis	*							
E Coprosma elliptica					*	*		*
E Coprosma waimeae					*	*		*
N Cordyline fruticosa	*	*	*	*				
N Crotalaria incana	?	?	?	?				
N Cuphea carthagenensis		*						
N Curcuma longa	?	?	?	?				
E Cyanea sp.						*		
E Cyanea sylvestris				*				
N Cynodon dactylon	?	?						
N Cyperus brevifolia	?	?	?	?				
N Cyperus gracilis	?	?	?	?				
? Cyperus sp.					*	*		
E Cyrtandra confertiflora var. confertiflora		*		*				
E Cyrtandra kauaiensis	?	?	?	?	?	?	?	?
E Cyrtandra paludosa					*	*		
E Cyrtandra sp.				*				
N Desmodium sandwicense	?	?	?	?				
N Desmodium triflorum	*	*						
E Dianella sandwicensis	*				*	*	*	
E Dichantherium hillebrandianum								*
E Dichantherium isachnoides								*

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= Cited in literature sources; needs confirmation in natural community

Status	Taxon	Kawelu Coastal Dry Cliffs	Hala Coastal Mesic Forest	Lama/Ohia Lowland Mesic Forest	Kukui Lowland Wet Forest	Ohia/Uluhe Montane Wet Forest	Ohia Mixed Shrub Montane Wet Forest	Ohia/Lapalapa Montane Wet Forest	Ohia Mixed Montane Bog
I	Dicranopteris linearis					*	*		*
N	Digitaria ciliaris	*	*						
N	Digitaria fuscescens	?	?	?	?				
N	Digitaria pentzii	?	?	?	?				
N	Digitaria setigera	?	?	?	?				
N	Dioscorea bulbifera				*				
E	Diospyros hillebrandii	*	*	*	*				
E	Diospyros sandwicensis		*	*	*				
E	Diplazium sandwichianum				*	*	*		
E	Diplopterygium pinnatum					*	*		*
E	Dodonaea viscosa		*						
E	Doodia kunthiana						*		
E	Doryopteris decipiens	*		*					
I	Drosera anglica								*
N	Drymaria cordata var. pacificae	?	?	?	?	?	?	?	?
E	Dryopteris glabra					*	*	*	
+ E	Dryopteris minuta						?	?	
N	Dryopteris sp.						*		
+ E	Dubautia knudsenii ssp. knudsenii						x		
+ E	Dubautia knudsenii ssp. nagatae						x		
E	Dubautia laxa					*	*	*	*
+ E	Dubautia microcephala						?	?	?
E	Dubautia raillardioides						*	*	
E	Dubautia sp.						*	*	
E	Dubautia waialealae								*
N	Ehrharta sp.					*			
E	Elaeocarpus bifidus			*			*		
N	Elaphantopus mollis		*	*					
E	Elaphoglossum alatum					*	*	*	
E	Elaphoglossum hirtum					*	*	*	
E	Elaphoglossum wawrae					*	*		
N	Eleocharis radicans						?	?	?
N	Eleusine indica	?	?	?					
N	Emilia sonchifolia var. javanica	*	*	*					
E	Eragrostis variabilis	*		*	*				
N	Erechtites valerianifolia		*	*	*	*	*	*	*
N	Erigeron karvinskianus	*	*	*	*				
E	Erythrina sandwicensis	?	?	?					
+ E	Eurya sandwicensis							*	
I	Fimbristylis dichotoma	*							

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Status Taxon

		Kawelu Coastal Dry Cliffs	Hala Coastal Mesic Forest	Lama/'Ohia Lowland Mesic Forest	Kukui Lowland Wet Forest	'Ohia/Uluhe Montane Wet Forest	'Ohia Mixed Shrub Montane Wet Forest	'Ohia/Lapalapa Montane Wet Forest	'Ohia Mixed Montane Bog
+ E	Flueggea neowawraea		?	?					
E	Freycinetia arborea		*	*	*				
E	Gahnia beecheyi					*	*		
I	Gahnia vitiensis ssp. kauiensis					*			
# E	Gardenia remyi		?	?	?	?			
# E	Geranium kauiense						?	?	?
E	Grammitis tenella					*	*		
E	Gunnera kauaiensis					*	*		
N	Hedychium flavescens				?	?	?	?	
E	Hedyotis acuminata				*	*			
+ E	Hedyotis cookiana						?	?	?
+ E	Hedyotis elatior						?	?	?
+ E	Hedyotis fluviatilis				*				
+ E	Hedyotis st.-johnii						?	?	?
E	Hedyotis terminalis			*		*	*		
I	Heteropogon contortus	?	?	?					
+ E	Hibiscus kokio ssp. saintjohnianus	*	*	*					
I	Hibiscus tiliaceus				?	?			
# E	Hibiscus waimeae ssp. hannerae		?	?					
+ E	Huperzia sulcinervia						*	*	
N	Hypochoeris glabra	?	?	?	?	?	?	?	?
E	Ilex anomala					*	*	*	*
N	Indigofera suffruticosa	?	?	?	?				
I	Ipomoea indica	?	?	?					
I	Ipomoea pes-caprae ssp. brasiliensis	?	?						
E	Ipomoea tuboides	?	?						
+ E	Isodendron longifolium	?	?	?					
+ E	Joinvillea ascendens ssp. ascendens	?	?	?	?	?	?	?	?
N	Juncus planifolius					*	*	*	*
N	Kalanchoe pinnata	*	*	*	*				
+ E	Kokia kauaiensis		?	?					
E	Korthalsella remyana					*	*		*
+ E	Labordia helleri		?	?					
E	Labordia hirtella					*			
+ E	Labordia pumila								?
E	Labordia sp.								*
E	Labordia waialeale					*	*		
+ E	Lagenifera erici								*
N	Lantana camara	*	*	*	*				

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+ E	<i>Lepidium serra</i>	*							
N	<i>Lepidium virginicum</i>	?	?	?					
N	<i>Leucaena leucocephala</i>	?	?	?					
E	<i>Lipochaeta connata</i> var. <i>acris</i>	?	?	?					
E	<i>Lipochaeta succulenta</i>	*	*						
E	<i>Lobelia gaudichaudii</i>					*	*	*	*
+ E	<i>Lobelia niihauensis</i>	*					?	?	?
+ E	<i>Lobelia yuccoides</i>						?	?	?
N	<i>Ludwigia octovalvis</i>				?	?	?	?	
E	<i>Luzula hawaiiensis</i>					*			
E	<i>Lycium sandwicense</i>	*				*			
N	<i>Lycopersicon</i> <i>pimpinellifolium</i>	?	?	?					
E	<i>Lycopodium cernuum</i>					*	*	*	*
E	<i>Lycopodium venustulum</i>						*		
+ E	<i>Lysimachia daphnoides</i>								?
I	<i>Lysimachia mauritiana</i>	*							
N	<i>Lythrum maritimum</i>	*							
I	<i>Machaerina angustifolia</i>			*	*	*	*	*	*
N	<i>Malvastrum coromandelianum</i>	?	?	?					
N	<i>Mangifera indica</i>				*				
E	<i>Marattia douglasii</i>					*	*		
I	<i>Mariscus javanicus</i>	?							
I	<i>Mariscus meyanianus</i>	?	?	?	?	?	?	?	?
N	<i>Melia azedarach</i>			?	?	?			
N	<i>Melinis minutiflora</i>	*	*	*					
E	<i>Metrosideros polymorpha</i>	*	*	*		*	*	*	*
E	<i>Metrosideros waialeale</i>						*		*
I	<i>Microlepis speluncae</i>						*		
N	<i>Mimosa pudica</i> var. <i>unijuga</i>	?	?	?					
N	<i>Mirabilis jalapa</i>	?	?	?					
N	<i>Momordica charantia</i>		?	?	?				
N	<i>Morinda citrifolia</i>		?	?	?				
+ E	<i>Munroidendron racemosum</i>		*	*					
N	<i>Musa</i> sp.		*						
E	<i>Myrsine alyxifolia</i>					*	*	*	
E	<i>Myrsine helleri</i>								*
E	<i>Myrsine lanaiensis</i>					*	*		
E	<i>Myrsine lessertiana</i>				*	*	*	*	
+ E	<i>Myrsine petiolata</i>						?	?	?
N	<i>Nasturtium microphyllum</i>		?	?	?				
N	<i>Nephrolepis</i> sp.		*	*	*				
I	<i>Nertera granadensis</i>					*	*	*	

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Status Taxon

		Kawelu Coastal Dry Cliffs	Hala Coastal Mesic Forest	Lama/'Ohi'a Lowland Mesic Forest	Kukui Lowland Wet Forest	'Ohi'a/Uluhe Montane Wet Forest	'Ohi'a Mixed Shrub Montane Wet Forest	'Ohi'a/Lepalapa Montane Wet Forest	'Ohi'a Mixed Montane Bog
+ E	Nesoluma polynesianum			*					
E	Nestegis sandwicensis			*					
N	Nicotiana tabacum		?	?	?	?			
+ E	Nothocestrum latifolium	?	?	?					
E	Nototrichium sandwicense	?	?	?					
+ E	Ochrosia kauaiensis			*	*				
I	Odontosoria chinensis		*						*
N	Oplismenus hirtellus		*	*	*				*
N	Opuntia ficus-indica	?							
E	Oreobolus furcatus								*
E	Osteomeles anthyllidifolia	?	?	?	?	?	?	?	?
N	Oxalis corniculata					*			
N	Oxalis corymbosa	?	?	?	?	?	?	?	?
I	Pandanus tectorius	*	*	*	*				
+ E	Panicum napaliense		?	?	?				
N	Paspalum conjugatum		*	*					
N	Paspalum dilatatum		*						
N	Paspalum scrobiculatum			?	?	?	?	?	?
N	Paspalum sp.		*						
N	Paspalum urvillei						*		
N	Passiflora edulis var. flavicarpa			*					
N	Passiflora laurifolia			?	?	?	?	?	
E	Pelea anisata					*	*	*	
E	Pelea clusiifolia					*	*	*	*
+ E	Pelea cruciata						?	?	?
+ E	Pelea puberula						?	?	?
E	Pelea sp.					*			
+ E	Pelea waialealae					*	*		*
E	Peperomia leptostachya	?	?	?					
E	Peperomia spp.		*		*	*	*	*	
N	Persea americana					*			
+ E	Peucedanum sandwicense	*	*						
N	Phaseolus lathyroides	?	?	?	?	?			
N	Philodendron sp.				?	?			
N	Phlebodium aureum	?	?	?	?	?	?	?	?
N	Phoenix sp.	?	?	?	?	?	?	?	?
N	Phymatosorus scolopendria		*						
N	Phytolacca octandra		?	?	?	?			
N	Piper methysticum				*				
E	Pipturus kauaiensis		?	?					
E	Pipturus sp.				*				
E	Pisonia sandwicensis			*					
E	Pisonia umbellifera			*	*				

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Status	Taxon	Kawelu Coastal Dry Cliffs	Hala Coastal Mesic Forest	Lama/'Ohi'a Lowland Mesic Forest	Kukui Lowland Wet Forest	'Ohi'a/Uluhe Montane Wet Forest	'Ohi'a Mixed Shrub Montane Wet Forest	'Ohi'a/Lapalapa Montane Wet Forest	'Ohi'a Mixed Montane Bog
E	Pittosporum gayanum					*	*		
+ E	Pittosporum napaliense			*	*				
N	Pityrogramma austroamericana	?	?	?					
N	Pityrogramma calomelanos	?	?	?					
N	Plantago lanceolata		?	?	?	?			
N	Plantago major		?	?	?	?			
E	Plantago pachyphylla								*
+ E	Platanthera holochila						?	?	?
E	Platydesma sp.						*	*	
E	Platydesma spathulata					*			
N	Plectranthus parviflorus	?	?	?	?				
E	Pleomele aurea		*	*	*				
I	Pleopeltis thunbergiana	*	*	*		*	*		
N	Pluchea indica	?	?	?					
N	Pluchea symphytifolia	*	*	*	*				
N	Poa compressa	?	?	?					
E	Polypodium pellucidum						*		
N	Portulaca pilosa	?							
E	Pouteria sandwicensis			*					
E	Pritchardia minor								*
+ E	Pritchardia napaliensis			*	*				
N	Prosopis pallida	?	?	?					
N	Psidium cattleianum			?	?	?			
N	Psidium guajava	*	*	*	*				
I	Psilotum nudum				?	?	?	?	
+ E	Psychotria grandiflora						?	?	?
E	Psychotria greenwelliae		?	?	?	?	?	?	
E	Psychotria kaduana		?	?	?	?	?	?	
E	Psychotria mariniana			*	*				
E	Pteridium decompositum						?	?	
E	Rauvolfia sandwicensis	*		*	*				
N	Rhynchelytrum repens	?	?	?					
E	Rhynchospora chinensis var. spiciformis						*		*
N	Ricinus communis	?	?	?					
N	Rubus argutus					*	*	*	*
E	Rubus hawaiiensis						*		
N	Rubus rosifolius			*	*	*	*	*	
N	Sacciolepis indica		*			*	*		*
E	Sadleria cyatheoides	*	*			*	*	*	*
E	Sadleria pallida					*			
E	Sadleria souleyetiana					*			
E	Sadleria squarrosa					*	*		

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Status Taxon

		Kawalu Coastal Dry Cliffs	Hale Coastal Mesic Forest	Lama/Ohi'a Lowland Mesic Forest	Kukui Lowland Wet Forest	Ohi'a/Uluhe Montane Wet Forest	Ohi'a Mixed Shrub Montane Wet Forest	Ohi'a/Lepalepa Montane Wet Forest	Ohi'a Mixed Montane Bog
N	Salvia occidentalis	?	?	?					
N	Samanea saman	?	?	?					
E	Santalum freycinetianum var. pyrularium				*				
E	Santalum sp.	*		*	*				
E	Scaevola glabra					*	*		*
I	Scaevola sericea	*	*						
N	Schefflera actinophylla		?	?	?	?			
+ E	Schiedea apokremnos	?	?	?					
N	Schizachyrium condensatum					*			*
E	Schizaea robusta						*		
N	Schizostachyum glaucifolium		?	?					
E	Selaginella arbuscula				*				
N	Senna occidentalis	?	?	?					
N	Setaria gracilis	*	*	*	*				
I	Sida fallax	*							
E	Sida sp.	*		*					
N	Sida spinosa	?	?	?					
N	Sigesbeckia orientalis	?	?	?					
E	Smilax melastomifolia					*	*	*	*
N	Solanum americanum				*				
N	Solanum capsicoides		?	?	?	?			
+ E	Solanum sandwicense	?	?	?					
N	Sonchus oleraceus	*							
N	Spathodea campanulata		?	?	?				
N	Spathoglottis plicata	*	*						
N	Spermacoce assurgens	?	?	?	?	?			
N	Sporobolus africanus	*	*	*					
N	Stachytarpheta dichotoma	?	?	?	?	?	?	?	?
N	Stachytarpheta jamaicensis	*	*	*					
N	Stachytarpheta urticifolia	*							
E	Stenogyne purpurea					*	*	*	
E	Sticherus owhyensis					*			
I	Styphelia tameiameia	*				*	*	*	*
N	Syzygium cumini	*	*	*	*				
N	Syzygium jambos		?	?	?	?			
N	Syzygium malaccense			*	*				
E	Syzygium sandwicense			*	*	*	*		
N	Tamarindus indica		?	?	?	?			
N	Tecomaria capensis		?	?	?	?			
N	Terminalia catappa		?	?	?	?			
E	Tetraplasandra kavaensis var. kavaensis			?	?	?	?	?	
E	Tetraplasandra waialeale					*			

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Status	Taxon	Kawelu Coastal Dry Cliffs	Hale Coastal Mesic Forest	Lana/'Ohi'a Lowia Mesic Forest	Kukui Lowland Wet Forest	'Ohi'a/Uluhe Montane Wet Fores	'Ohi'a Mixed Shrub Montane Wet Fores	'Ohi'a/Lapalepa Montane Wet Fores	'Ohi'a Mixed Montane Bog
N	<i>Thelypteris dentata</i>			?	?	?			
I	<i>Thelypteris interrupta</i>			?	?	?			
N	<i>Thelypteris parasitica</i>		*	*	*				
N	<i>Thespesia populnea</i>	?	?	?					
E	<i>Trematolobelia kauaiensis</i>						*		
E	<i>Trematolobelia macrostachys</i>					*	*	*	
E	<i>Trematolobelia</i> sp.					*	*		
E	<i>Urera glabra</i>				*				
E	<i>Vaccinium calycinum</i>					*	*	*	*
E	<i>Vaccinium dentatum</i>					*	*		
N	<i>Verbena litoralis</i>	?	?	?	?				
N	<i>Vernonia cinerea</i>		?	?	?	?	?	?	
I	<i>Vigna marina</i>	?	?	?					
N	<i>Vinca minor</i>		?	?	?	?			
E	<i>Viola kauaensis</i>								*
E	<i>Viola wailenalenae</i>					*	*		*
I	<i>Vitex rotundifolia</i>	?							
N	<i>Vulpia bromoides</i>	?	?	?					
I	<i>Waltheria indica</i>	?	?	?					
+ E	<i>Wikstroemia hanalei</i>			?	?	?			
E	<i>Wikstroemia oahuensis</i> var. <i>palustris</i>		?		?				
E	<i>Wikstroemia</i> sp.	*		*		*			*
+ E	<i>Wilkesia hobdyi</i>	*							
N	<i>Xanthium strumarium</i>	?	?	?					
E	<i>Xylosma hawaiiense</i>			*	*				
N	<i>Youngia japonica</i>	*		*	*				
N	<i>Zingiber zerumbet</i>				*				

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APPENDIX 4
Hono O Na Pali
Bird Species List

The following list was compiled from several sources. Information on native birds came from the Kauai Forest Bird Recovery Plan (USFWS 1983). Seabird information consists of incidental observations during this May 1988 survey, except 'A'o (USFWS and Telfer 1983) and 'Ua'u (Banko 1981), and is not intended to be comprehensive. Non-native birds listed were either seen during the survey, or known from adjacent areas and likely to occur. Taxonomy follows the Checklist of the Birds of Hawaii, by R. Pyle (1988).

Status	Species	Common Name	Source
E	<u>Asio flammeus sandwichensis</u>	Pueo, Hawaiian Owl	*
N	<u>Cardinalis cardinalis</u>	Northern Cardinal	*
E	<u>Chasiempis sandwichensis</u> <u>sclateri</u>	Kauai 'Elepaio	*
N	<u>Copsychus malabaricus</u>	White-rumped Shama	*
N	<u>Francolinus erckelii</u>	Erckel Francolin	*
I	<u>Fregata minor palmerstoni</u>	'Iwa, Great Frigatebird	*
N	<u>Garrulax canorus</u>	Hwamei	*
E	<u>Hemignathus parvus</u>	'Anianiau	*
E	<u>Hemignathus virens</u> <u>stejnegeri</u>	Kauai 'Amakihi	*
E	<u>Himatione sanguinea</u> <u>sanguinea</u>	'Apapane	*
E	<u>Loxops coccineus</u> <u>caeruleirostris</u>	Kauai 'Akepa	*
E	<u>Oreomystis bairdi</u>	Kauai Creeper	?
I	<u>Phaethon lepturus dorotheae</u>	White-tailed Tropicbird	*
I	<u>Phaethon rubricauda</u> <u>rothschildi</u>	Red-tailed Tropicbird	*
+E	<u>Pterodroma phaeopygia</u> <u>sandwichensis</u>	'Ua'u, Dark-rumped Petrel	*
+E	<u>Puffinus newelli</u>	'A'o, Newell Shearwater	x
I	<u>Sula leucogaster plotus</u>	Brown Booby	*
E	<u>Vestiaria coccinea</u>	'I'iwi	*
N	<u>Zosterops japonicus</u>	Japanese White-eye	*

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? = Cited in literature for area; needs confirmation in Reserve